

FERNS OF NORTH AMERICA.



THE FERNS OF NORTH AMERICA.

## COLORED FIGURES AND DESCRIPTIONS,

WITH SYNONYMY AND GEOGRAPHICAL DISTRIBUTION,

OF THE

# FERNS

(INCLUDING THE OPHIOGLOSSACEÆ)

OF THE

AND THE BRITISH NORTH AMERICAN POSSESSIONS.

BY

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THE DRAWINGS BY J. H. EMERTON AND C. E. FAXON.

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### ASA GRAY, LL.D.,

FOR THREE YEARS MY INSTRUCTOR, AND FOR MORE THAN TWENTY MY TRUE AND GENEROUS FRIEND, I DEDICATE THIS BOOK IN TOKEN OF MY AFFECTIONATE REGARD AND MY ADMIRATION FOR WHAT HE HAS DONE FOR SCIENCE.

DANIEL CADY EATON.

New HAVEN, April 17, 1879.



#### PREFACE.

Fern-lovers in North America have often expressed a wish for some work devoted to the illustration and description of the Ferns of the United States and the British Possessions. To meet this wish is the design of the present undertaking.

The sixty years which have elapsed since the publication of Nuttall's Genera of North American Plants have seen the number of recognized North American Ferns more than doubled. This great increase is due to a more general botanical interest in the older parts of the land almost as much as to discoveries in newly acquired territory. Nuttall gave the names of only seventy Ferns: in 1848, Kunze reviewed the list, adding about ten species to it, and rejecting several names as not representing distinct species, or as not belonging to any North American plant. About the same time the acquisition of New Mexico, Arizona and California, and the various governmental explorations of these regions, brought to our Flora about twenty-eight more Ferns, many of

which had long ago been described by Kaulfuss, and others were made known to botanists by Sir William Jackson Hooker in the early volumes of his Species Filicam. Most of these species are enumerated in the Report on the United States and Mexican Boundary Survey.

Increased activity among investigators of the Flora of the Northern States has now detected within the limits of the Republic all but one of the European species of Ferns which Drummond long ago discovered in the Rocky Mountains of British America. Of Ferns not previously known in North America, or entirely new to science, New England and the Northern States have yielded three species, and the Middle States (including Northern Alabama), four or five more; while the zeal of several collectors in Florida has brought up the number of Tropical Ferns known in that peninsula from four or five in 1818 to eighteen in 1877, and to twenty-three by April, 1879. At the same time, the explorers of California have made several discoveries of great interest; and the army of botanists everywhere have found many new stations for rare Ferns, and have greatly extended the known geographical range of commoner species.

The Ferns described in the fifth edition of Gray's Manual (1867) comprise fifty-seven species. Were a sixth edition to be prepared now, at least seven more species — Adiantum Capillus-Veneris, Cheilanthes Alabamensis, Asplenium parvulum, A. viride, A. Bradleyi, Trichomo nes

radicans and Botry. .ium matricaria folium—would each claim a place; and possibly some of the reputed varieties would have to be recognized as distinct species. Horace Mann's Catalogue of the Vascular Cryptogamia of North America, published in 1868, enumerates one hundred and twenty-four species of Ferns; Robinson's Check-list, of 1876, names one hundred and thirty-seven; and the species now attributed, by good authority, to that portion of our continent which is north of the Mexican boundary, are at least one hundred and forty-three, and will probably exceed that number before the present work is completed.

The plan adopted for this work is essentially that of Hooker's Filices Exoticæ. In order to extend the usefulness of the book, the definitions of species are written in English rather than in Latin, and they are often made to include some points of generic importance, thereby making the recognition of the species easier to the student. All the definitions are newly drawn up from actual specimens before the eyes of the author, living plants being used whenever obtainable. Ample references and synonymy are given, so that those who use the work may know where to look for the history of each species. The Habitat is generally given from specimens in my own collection, though sometimes taken from those preserved in the great herbaria at Kew and at Cambridge, or from facts kindly communicated by helpful correspondents. Under the Description, besides a more particular account

of the Fern itself, there will often be found some remarks as to its history, or its relation to other species, or perhaps some note as to its use in the arts of life, or as to the method of its successful cultivation. Little is said about the physiology of Ferns. It is a separate branch of botanical study, and persons wishing to pursue it can find excellent works suited to their purpose. I

The Ophioglossaceæ are included in this work, for, though they are not *Filices*, as is now well known, they are closely related to them, and are certainly *Ferns*, in the ordinary acceptation of the term.

The drawings have generally been made either from living plants or from specimens which I have selected for the purpose. As many of our Ferns are very much larger than the plates, it has been found necessary to draw some of them on a diminished scale. The number of plates being fixed at little more than half that of the species to be

I Consult Robinson's "Ferns in their homes and ours," Thome's "Text-book of structural and physiological botany," translated by A. W. Bennett, and especially the "Text-book of botany morphological and physiological," by Julius Sachs, translated and annotated by A. W. Bennett and W. T. T. Dyer. Still later, and not yet translated, is "Medicinisch-Pharmaceutische Botanik, i band. Kryptogamen."—Dr. Chr. Luerssen, Leipzig, 1879. This work contains a great deal of the Anatomy and Physiology not only of Ferns, but of all the orders of Cryptogamia, and is illustrated with 181 wood-cuts containing very many figures of a high order of excellence.

figured, it has often been necessary to represent several different Ferns on a single plate, and sometimes to crowd the drawings more closely than I could wish.

It remains for me to return thanks to Mr. Cassino, for the care he has taken in the whole work, and especially for his constant supervision of the printing and lithography; to the artists, Mr. Emerton and Mr. Faxon, for their skilful delineations, and for the patience with which they have listened to my suggestions; and to Messrs. Armstrong and Company for the carefulness with which they have transferred the original drawings to stone.

I am grateful to very many kind correspondents who have favored me with specimens of Ferns, or with valuable memoranda, from all parts of the United States and the Dominion of Canada. I have scarcely ever had occasion to ask for a specimen or for an item of information without the favor sought being granted most courteously and kindly. The names of these correspondents will be found recorded in connection with the species they have furnished.

More than general thanks are due to a few persons who have taken pains to send me unusually large and fine collections; and here I would speak of the disinterested kindness of Hon. T. M. Peters, Dr. A. P. Garber, Mrs. Ellwood Cooper, Mrs. R. M. Austin, Mrs. Mary E. Pulsifer Ames, and many others.

Mr. George E. Davenport has helped me in many ways during the preparation of this work, and Hon. J. Warren Merrill has furnished living plants of certain species for the use of the artist.

With the last Part of this work it is intended to print a Systematic Conspectus of all the Genera and Species of North American Ferns, giving brief diagnostic characters and references to the page and plate where each species is described and figured.

DANIEL CADY EATON.

New Haven, April, 1879.

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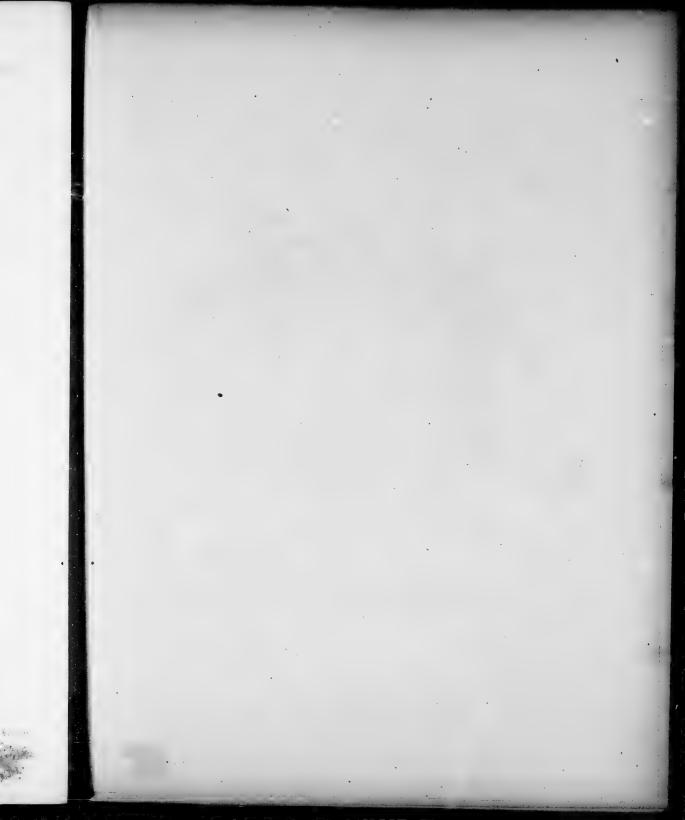
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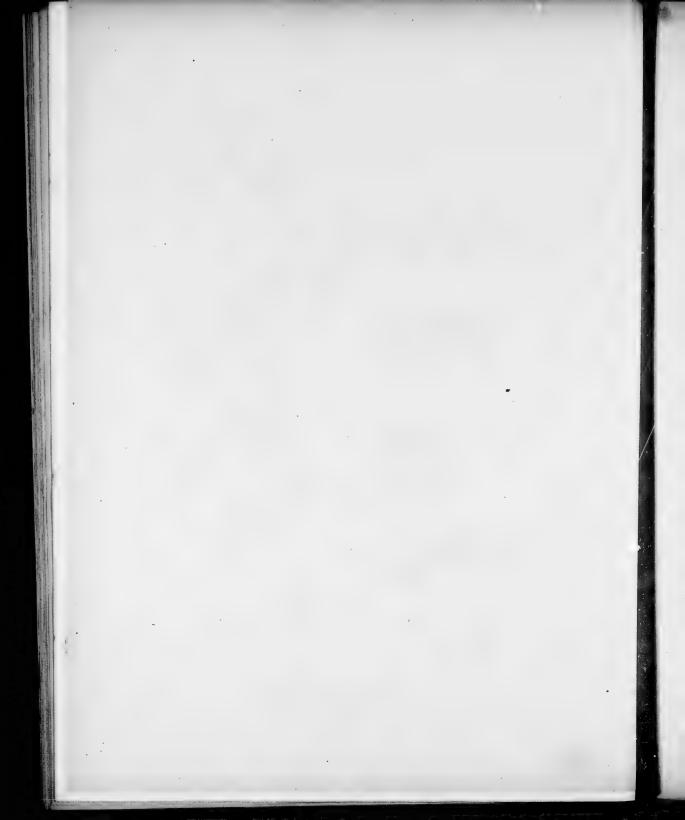




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Hoot of Climburg Fern
LYCHILLM PALMATUM
SWARTZ





#### PLATE I.

#### LYGODIUM PALMATUM, SWARTZ.

#### Climbing-Fern.

Lygodium Palmatum: — Root-stock very slender, widely creeping; fronds two to five feet high, smooth; the stalks twining or climbing, greenish, drying brownish straw-color; the branches scattered, forking near the base, and bearing in pairs on slender petioles cordate-reniform five-to-seven-lobed frondlets or pinnæ, one to two or even three inches broad; the upper portion of the fruiting-fronds paniculately decompound; the pinnules mostly three-lobed, the lobes with from six to ten alternate imbricating indusia, a single oval or acorn-shaped sporangium under each.

Lygodium palmatum, Swartz, Syn. Fil., p. 154.—Schkuhr, Fil., p. 141, t. 140.—Bigelow, Florula Boston. ed. iii., p. 415.—Gray, Manual, ed. i., p. 634, et ed. seq. omn.—Hooker, Filices Exoticæ, t. 24.—Hooker & Baker, Syn. Fil., p. 436.

Gisopteris palmata, BERNHARDI, in Schraders Journal, 1801, i., p. 129.

Hydroglossum palmatum, WILLDENOW, in Act. Acad. Erford, 1802, p. 25,

t. 1, f. 2; Sp., pl. v., p. 84. — Pursh, Flora Amer. Sept. ii., p. 656.

Cteisium paniculatum, Michaux, Flora Bor. Am., ii., p. 275.

Ramondia palmata, Mirbel, "Bull. Soc., Phil., an. xi., p. 179."

HAB. — In low, moist thickets, and damp, open woods; from Massachusetts to Virginia, Eastern Tennessee, and even Florida; not known far west of the Alleghanies. The fruit ripens in September.

DESCRIPTION. — The climbing-fern, creeping-fern, Hartfordfern, or Windsor-fern, as it is variously called, has a long and very slender root-stock, scarcely one line in diameter. This rootstock creeps just under the surface of the ground to a distance of several inches, or nearly a foot, in one season. The growing extremity of it is scantily furnished with short, semi-pellucid jointed hairs. The root-stock is of a very dark brown color, almost black: it bears on the under side short, straggling roots; and from the upper side, some distance from the newest portion, arise, at a distance apart of one or two inches, the delicate climbing fronds. The stalk or stipe is dark at the base, but at a few inches above the ground becomes paler: in the growing plant it is greenish, but becomes of a dull brownish straw-color when dried. It is very slender, — not more than half a line in thickness, — and yet has considerable strength. A transverse section is roundish triangular; all the outer part composed of dark brown, firm, thick-walled wood-cells, while in the centre is seen a small circular portion of scalariform ducts and parenchyma. The fronds creep and climb and twine themselves over other plants to the height of three or four feet, or even more. The sterile fronds are strictly bipinnate, and so also is the lower part of the fertile fronds. Beginning at six or eight inches from the ground, the twining midrib or rachis bears very short branches one or two inches apart. These branches divide, at about one-eighth of an inch from the midrib, into two slender petioles something less than an inch long, and each petiole supports at its end a kidney-shaped, deeply-lobed leaflet or pinna. These pinnæ are usually about an

inch and a half broad, having a deeply-rounded sinus at the base, and are palmately cleft into from four to seven, rarely more, oblong or linear-oblong, entire or obscurely-crenulate, obtuse lobes. The veining resembles slightly the branching of our common maiden-hair. From the base of the leaflet arise two veins, which diverge, and are recurved to right and left. These bear, on the upper side, a few straightish primary branches, each forming the mid-vein of a lobe of the leaflet. From each mid-vein veinlets arise very obliquely, forking usually twice, and gradually curve outward to the edge of the lobes.

The texture of the pinnæ is rather delicate, — what may be called papyraceo-herbaceous, — and the color is a fine, clear leafgreen. The surfaces seem to be smooth, though a few scattered hairs have been detected along the veinlets on the under surface. In the fruiting-fronds, several of the uppermost pairs of leaflets are paniculately decompound, being bipinnately divided, the pinnules usually three-lobed or three-cleft, but sometimes two-to-fivecleft. The lobes are about two lines long, half a line broad, and have one central vein, along each side of which, on the under surface, is a row of four to eight convex ovate imbricating scales, or involucres, each one affixed to the upper side of a very short lateral branch of the central vein, to which branch, under each involucre, is attached a single obliquely-ovate reticulated capsule or sporangium. The sporangia are comparatively large, and have at the smaller end a sort of radiated cap, which is homologous with the incomplete vertical ring of the sporangia in such ferns as Polypodium and Aspidium. These sporangia open by a longitudinal cleft when ripe, and discharge the minute pellucid spores.

The climbing-fern of our Eastern States is the only species of the genus in the territory of the United States; and, indeed, no other Lygodium anywhere attains so high a latitude. The genus is characterized by the separately involucrate sporangia, by the climbing habit of the fronds, and by the leaflets, or pinnæ, being arranged in pairs on short common foot-stalks. About sixteen other species are known, mostly inhabitants of tropical America, tropical Asia, Australia and Polynesia, all of them larger plants than ours, the leaves more compound, and the fronds climbing often to the height of many feet. Lygodium scandens (Swartz), from Southern China, &c., is frequently seen in cultivation in conservatories, and two or three other species less commonly. The sub-order to which Lygodium belongs is usually named Schizæaceæ: it includes, besides this genus, the genera Schizæa, Aneimia, Mohria, and Trochopteris, and is characterized by the horizontal apical ring, or radiated cap, of the sporangia. Schizæa and Aneimia, genera of a considerable number of species, have each one or two species within the United States; while Mohria, of a single species, is confined to South Africa and the neighboring islands; and Trochopteris, likewise monotypic, is found only in tropical America.

Lygodium palmatum grows abundantly in certain favored localities; but between them are great regions where it seems to be utterly wanting. Near Concord in Massachusetts is its most north-easterly known station. It is found plentifully near Sun-

derland, Mass.; near Windsor, Plainville, and Manchester, Conn.; in several counties of New Jersey; in Monroe County, and perhaps other parts of Pennsylvania; is named in a catalogue of Ohio plants; and occurs, how profusely is not known, in Virginia, Kentucky, Tennessee, the Carolinas, Georgia, probably Alabama, and even in Florida (*Chapman*). For many years it was unknown in New York; but in 1873 it was discovered by Miss MARY C. REYNOLDS in the town of Hunter, Greene County, N.Y.

The carefully pressed fronds are much used as an article of parlor ornament or decoration in the cities of Connecticut, and the custom is spreading to other States. The plant is gathered in August and September, and is exposed for sale in Hartford, New Haven, and New York, in great quantities, both in the fresh condition and as pressed specimens. Indeed, the gathering of it became so destructive, that in 1869 the legislature of Connecticut passed a special law for its protection. This law has since been codified in the revision of the statutes of 1875; and under title xx., chap. iv., sect. 22, it is made an offence, punishable by a fine not exceeding one hundred dollars, or imprisonment not more than twelve months, or both, to wilfully cut, destroy, or take away from the land of another person any "cranberries, creeping-fern, crops, shrub, fruit, or vegetable production."

Probably this is the only instance in statute law where a plant has received special legal protection solely on account of its beauty.

The plate represents a frond of the climbing-fern, a fruiting segment, magnified, and a sporangium, highly magnified.



#### PLATE II. Fig. I.

#### CHEILANTHES COOPERÆ, D. C. EATON.

#### Mrs. Cooper's Lip-Fern.

CHEILANTHES COOPERÆ:—Stalks densely tufted, variable in length, brownish, fragile, hairy, like the frond, with somewhat entangled or straightish nearly white articulated often gland-tipped and viscid hairs; frond three to eight inches long, ovate-lanceolate, bipinnate; the rather distant pinnæ oblong-ovate; pinnules roundish-ovate, crenate, and incised; the ends of the lobules reflexed, and forming herbaceous involucres; segments at first slightly concave, becoming flat at maturity.

Cheilanthes Cooperæ, D. C. EATON, in Bulletin of the Torrey Botanical Club, vi., p. 33 (May, 1875).

HAB. — California, in clefts of rocks and on mountain-sides; near Santa Barbara, Mrs. Ellwood Cooper; Downieville Buttes, Mr. J. G. Lemmon; near San Bernardino, Dr. C. C. Parry and Mr. Lemmon.

Description.—The root-stocks are short, entangled, ascending rather than creeping, and covered, especially near the growing end, with narrow, linear-acuminate, crisped, dark-brown scales. The stalks are crowded together, erect or curved; half to two-thirds of a line thick; two to four inches long; dark chestnut-brown; shining, but hirsute-pubescent, as is the whole frond, with pale-brown or whitish jointed hairs, which are more or less

viscid, and some of them evidently tipped with a minute globular gland.

The frond is as long as the stalk, or even longer; is oblongovate or ovate-lanceolate in outline; bipinnate, or, in the larger
specimens, approaching tripinnate. The lower pinnæ are rather
distantly placed, opposite or alternate, oblong-ovate in shape, six
to nine lines long; the pinnules crenately incised; the lobules
with the ends recurved, and forming separate herbaceous involucres. The upper pinnæ are gradually smaller and more closely
placed. As the sporangia ripen, the involucres are pushed back,
so that the lobes and segments are at length flattened out. The
hairiness of the frond is so abundant as to partially obscure the
divisions of the pinnæ. The texture is herbaceous, and the general color a dull grayish-green.

This little fern bears considerable affinity to *Cheilanthes vestita* (Swartz), which is well known from New York to Illinois and Georgia, and has been collected as far west as Kansas. *C. Cooperæ* has the same general appearance, and similar herbaceous involucres, but is commonly of smaller size, and is very distinct in the character of the pubescence, as the hairs of the Eastern plant are never viscid and glandular. On first receiving it, I supposed it might be a Northern form of *C. pilosa*, from the Andes of Peru; but, having now obtained a specimen of that fern through the kindness of Mr. Baker of the Kew Gardens, it is evident that the present is distinct in its smaller size, narrower pinnules, and in some other respects. Both species differ from *C. vestita* in bearing glanduliferous hairs.

Mrs. Sarah P. Cooper and her husband, Ellwood Cooper, Esq., of Santa Barbara, are both well known as taking great interest in the development of California, especially in the direction of education, agriculture, and natural history. Mrs. Cooper has sent to the Eastern States fine collections of ferns, and also of the marine algæ which the shores of California produce in great abundance and in beautiful variety.

Plate II., Fig. 1.—An entire plant of *Cheilanthes Coopera*, and above it, to the right, a portion of a pinna enlarged, and one of the gland-tipped hairs highly magnified.



## SYNOPSIS OF THE SPECIES OF CHEILANTHES KNOWN TO OCCUR IN THE UNITED STATES.

#### Cheilanthes, Swartz, Syn. Fil., p. 5, 126.

- §1. ADIANTOPSIS. Involucres separate, one to each fertile veinlet.
  - 1. C. Californica, METTENIUS (California).
- §2. EUCHEILANTHES. Involucres more or less confluent, usually extending over the apices of several veinlets, but not, or very rarely, continuous all round the segment.
  - \* Segments of the frond smooth.
  - 2. C. Wrightii, HOOKER (Texas to Arizona).
  - 3. C. microphylla, SWARTZ (New Mexico).
  - 1. C. Alabamensis, Kunze (Carolina to Texas).
  - \*\* Frond somewhat hairy, or hairy and glandular, but not tomentose,
    - 5. C. leucopoda, LINK (Texas).
    - 6. C. vestila, Swartz (New York to Georgia, Illinois, and Kansas).
    - 7. C. Cooperæ, D. C. EATON (California).
- §3. Physapteris or Myriopteris. Ultimate segments minute, rounded; involucre usually continuous all round the margin. Fronds, in all our species, twice to thrice pinnate, with the lower surface tomentose or scaly, the tomentum or scales at first white, often becoming tawny as the fronds mature.
- \* Frond tomentose beneath, but not scaly (except along the rachises in No. 11)

- † Upper surface nearly or quite naked; fronds rarely more than twice pinnate.
  - 8. C. gracillima, D. C. EATON (California to British Columbia).
- †| Upper surface decidedly pubescent; fronds thrice pinnate in well-developed plants.
  - C. lanuginosa, NUTTALL (Illinois to the Rocky Mountains of British America, Colorado, and Arizona).
  - 10. C. tomentosa, LINK (Carolina to Texas).
  - II. C. Eatoni, BAKER (Texas to Arizona).
  - \*\* Frond covered beneath with imbricated scales, but not tomentose.
    - 12. C. Fendleri, HOOKER (Texas to California).
    - 13. C. Clevelandii, D. C. EATON (California).
    - \*\*\* Under surface of pinnules both tomentose and scaly.
      - 14. C. myriophylla, Desvaux (Nevada to Arizona).
      - 15. C. Lindheimeri, HOOKER (Texas to Arizona).
- §4. ALEURITOPTERIS. Involucres various, confluent or distinct. Fronds covered beneath with a white or yellow powder.
  - 16. C. argentea, Hooker (Alaska, doubtfully).





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CHAILATE BERTHAN FIG.1 - BERTHAN FIG.1



#### PLATE II. - Fig. 2.

# CHEILANTHES VESTITA, SWARTZ.

### Clothed Lip-Fern.

CHEILANTHES VESTITA: — Root-stocks creeping, entangled, covered with narrow light-brown scales; fronds herbaceous in texture, six to fifteen inches high, oblong-lanceolate, hirsute, like the blackish and shining stalks, with straightish prominently articulated rusty hairs, bipinnate; pinnæ triangular-ovate, the lower pairs rather distant; pinnules flat, ovate-oblong, obtuse, crowded, more or less toothed or incised, the ends of the roundish or oblong lobes reflexed, and forming separate herbaceous involucres, which are pushed back by the ripened sporangia.

Cheilanthes vestita, Swartz, Syn. Fil., p. 128 (1806). — Schkuhr, Krypt. Gew., p. 116, t. 124. — Gray, Manual, ed. i., p. 625. — Eaton, in Gray, Manual, ed. v., p. 659. — Hooker & Baker, Syn. Fil., p. 134. — Mettenius, über Cheilanthes, p. 29.

Adiantum vestitum, Sprengel, Anleit., p. 112 (1804); Eng. version, p. 135. Acrostichum hispidum, Bosc d'Antic, fide Sprengel.

Adiantum hispidum, Bosc, fide Swartz.

Polypodium lanosum, MICHAUX, in herb.!

Nephrodium lanosum, MICHAUX, Fl. Bor. Am., ii., p. 270! (1803.)

Aspidium lanosum, SWARTZ, Syn. Fil., p. 58.

Cheilanthes lanosa, D. A. Watt, in Journal of Botany, February, 1874, p. 48: not of Moore, Index Fil., p. 245, nor of Eaton, Mex. Boundary Botany, p. 234, which synonyms belong to Ch. lanuginosa, Nuttall.

Hab. — Clefts and ledges of rocks, from the Island of New York westward to Illinois, Missouri, and Kansas, and southward to the Carolinas and Georgia.

DESCRIPTION. - Root-stocks creeping, much matted and entangled, and sometimes forming large tufts. They are nearly as thick as a goose-quill, and are densely covered with amberbrown, linear-acuminate, ciliate-toothed scales. Stalks from three to six inches long, wiry, dark-brown or blackish, moderately polished, and, like the rachis, hirsute with variously directed light rusty-brown jointed hairs. These hairs are mostly fine-pointed, and are composed of three, four, or five joints, with very evident articulations. The fronds are usually six to eight inches long, and one to one and a half inches wide, but are occasionally larger, and very often considerably smaller, than these dimensions: in outline they are narrowly oblong or oblong-lanceolate; and they are bipinnate, or, in large plants, nearly tripinnate. The texture is herbaceous; and the surfaces, especially the lower surface, are hirsute with rusty hairs like those of the stalks and rachis. The pinnæ are mostly opposite, the lower two or three pairs more distant than the upper ones, triangular-ovate, sessile, or nearly so; pinnules of similar shape, and crenately incised, or, in larger fronds, pinnatifid with crenated lobes, the lobes rounded at the ends. In young fertile fronds the ends of the lobes are narrowly recurved, so as to cover the sporangia, forming an obscure herbaceous involucre; but, as the sporangia ripen, this is pushed back, and the lobes at length appear quite flat. The general color of the frond is a dull green, shaded with rusty-brown.

Michaux's name, Nephrodium lanosum, is undoubtedly the first published of the various names for this fern, as a comparison of the dates will show. But I can scarcely agree with Mr. Baker "to take up the oldest specific name independent of genus." The generic name is the "nomen substantivum," the specific name only an adjective; and I should decidedly prefer to retain, in use the first reasonably appropriate published name under which any species was correctly referred to its true genus. Moreover, I think the usage of many of the most distinguished systematists—for instance, the De Candolles, both the Hookers, Bentham, Gray, &c.—will be found to sustain this preference. Usually it is well to keep the oldest specific name when it is known; but there is no absolute law requiring it; and to endeavor to replace well-known specific names by older, but obscurer ones, is surely reprehensible.

The station on Manhattan Island, on rocks with an eastern exposure, near Fort Tryon, is the most northern known, and was discovered in 1866 or 1867 by the late Mr. W. W. Denslow. The species was also collected on Snake Hill, in Hackensack Swamp, N.J., by Dr. F. J. Bumstead, in 1865.

Plate II., the upper figure, represents a single rather large frond of *Cheilanthes vestita*, with the root-stock, &c. On the right are figures of a fruiting pinnule enlarged, and of one of the jointed hairs highly magnified.











#### PLATE III.

### ASPLENIUM SERRATUM, LINN.

### Serrated Spleenwort.

Asplenium Serratum:—Fronds growing in a crown from a short thick erect root-stock, simple, subcoriaceous or chartaceous, one and a half to two and a half feet high, three to four inches broad, spatulate or linear-oblanceolate, narrowed from the middle down to the very short stalk, the apex subacute or short-acuminate, the edges crenulate or (more commonly) finely but irregularly serrate; midrib stout, slightly channelled above, keeled and often blackish purple beneath; veins closely placed, free, rising from the midrib at an angle of about sixty-five degrees, mostly once forked near the midrib, and running out into the teeth of the margin; sori very much elongated, following the veins of the upper half of the frond from near the midrib half way to the margin; involucres single, the free edge entire.

Asplenium serratum, Linn, Sp. Pl., p. 1538.—Swartz, Syn. Fil., p. 74.—Willdenow, Sp. Pl., v., p. 304.—Schkuhr, Crypt. Gew., p. 61, t. 64.—Hooker, Fil. Exot., t. 70; Sp. Fil., iii., p. 81.—Hooker & Baker, Syn. Fil., p. 193; &c., &c.

Asplenium nidus, RADDI, Fil. Brasil, p. 34, t. 53 (not of Linnæus).

Asplenium crenulatum, Prest, Tentamen Pteridographiæ, p. 106 (founded on Raddi's plate).

Lingua cervina longo lato serratoque folio, Plumier, Traité des Fougères de l'Amérique, p. 108, t. 124.

HAB.—"Six tusts of it in a low damp hummock bordering on the Everglades, Florida;" discovered April, 1877, by A. P. GARBER, Esq. Common in the West Indies, and in Tropical America from the Isthmus of Panama (Scemann, Hayes) to Brazil.

DESCRIPTION. — Root-stock short and thick, erect, with abundant rootlets covered with crisp brown wool. The stalk or stipes is very short, — rarely more than an inch long, and often much less, — concave on the upper or inner side, and much carinated or keeled on the other, the lamina of the frond forming a very narrow wing or border to the very base. Just where the stipes leave the root-stock there is an abundant growth of narrowly linearacuminate, dark fuscous-brown scales, nearly half an inch long. Otherwise the stipes and the frond are perfectly smooth. The fronds are very numerous from one root-stock, and rise from it crect or obliquely, gracefully curving outwards in all directions, the tips often somewhat drooping. Their length is from a foot and a half to nearly three feet; and, from the middle to near the end, they have a breadth of from two and a half to four inches. From near the middle they taper gradually downwards to the base, and become more and more concave or channelled, so as to carry the rain-water to the roots. When fresh, the texture is firmly chartaceous, or almost coriaceous; but specimens long dried become very brittle. The veins are closely placed, about twenty to the inch, a few of them unbranched, but most of them forking near the base, or even divided into three. They are very straight, and diverge from the midrib at an angle of from sixty to seventy degrees. The tips of the veins are within the marginal teeth of the frond, but do not reach to the very points of the teeth. The Florida specimens are quite sharply serrated, as are specimens collected in Cuba by Mr. Wright, and in Santo Domingo by the botanists attached to the United States Commission of Inquiry; but specimens from Panama, collected by Mr. SUTTON HAYES, and from New Granada (Mr. A. SCHOTT), are obscurely crenulated, like the Brazilian form figured by RADDI. The sori are mostly confined to the upper half of the frond, occasionally descending nearer the base, and are very narrow and about an inch long, running along the superior side of the veins, or of most of them, from near the midrib half way, or a little more than half way, to the margin. The midrib is very stout in the lower portion of the frond, and is there much developed on the lower or outer surface; so that a section of it is triangular, and shows a double band of vascular tissue. The color of the frond is a fine leaf-green, slightly glossy on the upper surface, and a little paler and duller beneath. The under side of the midrib shows more or less of a deep purple, especially in the living plant.

This noble species is the latest addition to the fern-flora of the United States; and Mr. Garber is to be congratulated on so fine a discovery. The number of typical West-Indian ferns which have now been found in Florida is considerable; the list embracing Acrostichum aureum, Polypodium Plumula, P. Phyllitidis, P. aureum, Pteris longifolia, Pt. Cretica, Vittaria lineata, Blechnum serrulatum, Asplenium serratum, A. dentatum, A. myriophyllum, Aspidium patens, A. unitum, var. glabrum, Ne-

phrolepis exaltata, Aneimia adiantifolia, Ophioglossum bulbosum, O. nudicaule, and O. palmatum, — eighteen in all. Three of these — Aspl. serratum, Aspid. unitum, and Ophioglossum palmatum — have been brought to our knowledge within the last few years, since the publication of Dr. Chapman's "Flora of the Southern States;" and it can scarcely be rash to hazard the conjecture, that there are yet in the swamps and hummocks of Florida more undiscovered tropical ferns to reward the diligent explorer.

A few foreign ferns are more or less closely related to the present species. A. sinuatum (Beauvois), from the coast of Guinea, is perhaps the most like it, having the same habit, and nearly as ample dimensions; but the midrib is very prominent on the upper, not the under, surface. The bird's-nest fern (Asplenium Nidus (L.), from South-eastern Asia and Australasia, is also similar in habit to our plant, and is even grander in its proportions; but it belongs to a separate section of the genus (§Thamnopteris), characterized by having the veinlets connected at their tips by a transverse intramarginal vein. There is certainly no North-American fern with which Asplenium serratum could be confounded.

Plate III. represents an entire plant, reproduced from a sketch by Mr. Garber, about one-eighth natural size; also a fruiting-frond, natural size, and a small portion from near the middle, magnified to twice the natural size.









PLATE IV .- FIG. 1.

# ASPLENIUM EBENEUM, AITON.

### Ebony Spleenwort.

Asplenium ebeneum:—Root-stock short, creeping; stalks short, dark reddish-brown or nearly black, and polished, as is the rachis; fronds erect, a span to a foot or more high; firm-membranaceous, narrowly linear-oblanceolate, moderately acuminate, pinnate; pinnæ numerous, mostly horizontal and alternate, usually crowded, oblong or oblong-linear, half an inch to an inch and a half long, sessile, dilated or auricled on the upper or on both sides of the base, crenate or serrate or even incised, mostly obtuse, the lower ones gradually shorter and deflexed; sori oblong, oblique, numerous, nearer the costa than the margin, often confluent at maturity.

Asplenium ebeneum, Aiton, Hortus Kewensis, ed. i., iii., p. 462. — Swartz, Syn. Fil., p. 79. — Willdenow, Sp. Pl., v., p. 329. — Bigelow, Flor. Bost., p. 422. — Torrey, Flora of New York, ii., p. 492. — Gray, Manual, ed. omn. — Hooker, Sp. Fil., iii., p. 139.

Acrostichum platyneuron, LINNÆUS, Sp. Pl., p. 1527.

Polypodium auriculatum, LINNÆUS, Herb. (in part)!

Asplenium polypodioides, Swartz, "Schrad. Journ., 1800, ii., p. 53;" Syn. Fil., pp. 79, 272. — Schkuhr, Krypt. Gew., p. 67, t. 73.

Asplenium trichomanoides, MICHAUX, Fl. Bor. Am., ii., p. 265!

HAB. - Canada and New England southward to Florida, and westward

to Indian Territory (Dr. EDWARD PALMER) and Louisiana. It is found commonly on sunny or partially-shaded rocky hillsides, but occurs not unfrequently in moister places. The sporangia mature in midsummer or early autumn.

Description. — The ebony spleenwort, so called from the nearly black and shining stalks and rachis, has a short and rather stout creeping or ascending root-stock, which is covered by the bases of old stalks. The stalks are seldom more than two inches long: they are nearly terete, and contain a single slender vascular bundle. The young stalks, and the very bases of the mature ones, bear a few narrow, slender-pointed, black-fuscous scales, composed of thick-walled, oblong-rectangular cells arranged in longitudinal rows, looking under the microscope like some kind of lattice-work. The fronds are usually six or eight in number, and stand nearly erect, but commonly all facing towards the light, some of them making a twist to do so. They are firmly membranaceous in texture, quite smooth, and remain green until late in the fall, or even in favorable places until the spring. The earliest fronds of each season's growth are sterile, and much shorter than the later fertile ones, which are commonly from six to twelve inches high, but sometimes in moist situations attain twice that height. The outline of the fronds is linear, tapering gradually to the base from near the middle, and with an acute pinnatifid apex. The pinnæ are sessile and closely placed, often overlapping each other a little at the dilated and somewhat auricled bases. The auricles are commonly most developed on the superior margin; but not unfrequently the lower margin is almost

as much auricled as the other, making the bases of the pınnæ cordate-hastate, so that they nearly cover the upper side of the rachis. On any frond of ordinary size there will be found about forty pinnæ, - the middle ones eight to ten lines long and about two lines broad, spreading at right angles to the rachis, often subfalcate; the lower ones gradually shorter, more and more deflexed, and the auricles on each side of the base more nearly equal; the very lowest only two or three lines long. The margin is commonly serrate; in very small plants barely crenate, and in luxuriant ones incised, with serrated lobes. There is a well-marked mid-vein or costa, with simple or branched veins pinnately arranged on either side. The sori, from eight to fifteen in number, are borne near the costa, always leaving uncovered the green herbaceous margins of the pinnæ. The indusia are very delicate, three or four times as long as they are broad; and when the frond is young they give to the under surface a bright silvery appearance.

The name "var. serratum" has been proposed by Mr. Elihu Miller (Torrey Bot. Club Bull., iv., p. 41) for the large form with incised pinnæ; but the normal condition of the pinnæ is to be serrate.

This fern is said to have been found in South Africa also; but I have not seen specimens from that region.

Var. minus (Hooker, Sp. Fil., l. c.), which is found from Tennessee to Mexico and Peru, will be described in a later number of this work under the name of Asplenium parvulum (Martens and Galeotti). To this plant belongs the A. trichomanoides

of Dr. Mettenius, and probably of Kunze also, but not that of Michaux.

Although the Linnæan name for the present fern is unquestionably the oldest, it is scarcely probable that those authors who are disposed to insist upon an inflexible law of priority will attempt to replace the name which has been accepted by nearly all botanists for nearly a century by one so utterly inappropriate as platyneuron. Yet, lest they should do so, it may be worth while to note that this fern was named Asplenium platyneuron by the late Mr. Oakes of Ipswich, in a marginal note in a copy of the old "Flora Virginica," now in my possession.

Plate IV., Fig. 1, represents a specimen of the common form in New England, together with a few pinnæ of the more serrated or incised varieties, and a small portion of a pinna, somewhat magnified.

#### PLATE IV. - Fig. 2.

## ASPLENIUM EBENOIDES, R. R. Scott.

### Scott's Spleenwort.

ASPLENIUM EBENOIDES:—Fronds four to nine inches long, broadly lanceolate, pinnatifid, pinnate near the base, the apex elongated and slender; divisions lanceolate from a broad base, crenate, some of them elongated and often proliferous, as is the apex of the frond; the lowest divisions distinct, shorter; sori numerous on the divisions and on the long apex, mostly single and opening obliquely upwards, but some of them double, and others facing each other in pairs; stalk blackish and shining, as is also the lower part of the rachis, especially on the under side.

Asplenium ebenoides, R. ROBINSON SCOTT, MS. and in BERKELEY'S notice in Journ. Royal Horticult. Soc., 1866, p. 87, t. 2, f. 1.—EATON, in Gray's Manual, ed. v., p. 661.—Leggett, in Torrey Club Bull., iv., p. 17.

Hab.—On limestone cliffs of the Schuylkill River near Philadelphia, Scott, F. Bourquin; near Havana, Central Alabama, Miss Tutwiler; on limestone in Canaan, Conn., J. S. Adam.

Description.—The stalk is slender, polished, and nearly black, the color extending on the under side as far as the middle of the frond, or a little farther. The frond is composed of a tapering crenate apex two or three inches long, and of a number of

lateral segments on each side, the upper ones closely placed, and connected by a broad wing along the midrib, and the lower ones gradually more distinct, the lowest quite so, and often a little auricled above and below. The apex is often proliferous, and so are a few of the longest segments. The texture is firmly membranaceous, and the surfaces perfectly smooth. The sori are in a single row on each side of the midrib of the terminal prolongation, and similarly on the segments, rather short, and mostly of the proper Euasplenium type,—that is, single, and with the indusium opening upwards and inwards; but near the base of nearly every segment are a few diplazioid or scolopendrioid sori, with double indusia placed back to back on the same veinlet in one case, and face to face on contiguous veinlets in the other. The veins are everywhere free.

This curious plant has now been found in three or four different and widely-distant localities, but always in the immediate company of the walking-leaf (Camptosorus) and the ebony spleenwort (A. ebeneum). While it differs from the first by its dark and shining stalk and rachis, in its free veins, and by its pinnatifid or sub-pinnate frond, it resembles it strongly in the prolonged and slender apex, in the irregular sori, and especially in its proliferous habit; and, in the very respects in which it differs from this, it resembles the other. For these reasons, Rev. M. J. Berkeley, in the article cited on the preceding page, is strongly inclined to suspect that it is a true natural hybrid of the two. That this view is correct certainly appears probable; but it can only be established by a successful attempt to produce the present plant

by artificial hybridizing; and I would strongly recommend this attempt to those persons who have facilities for experiments of the kind.

Mr. Merrill of Cambridgeport has had *A. ebenoides* in cultivation for some time, and finds it easy to multiply plants by caring properly for the proliferous buds.

There is an Asplenium Hendersoni, figured by Lowe at Plate 12 of the fifth volume of his work on Ferns, which bears considerable resemblance to our plant, but lacks the long and slender apex, and apparently is not proliferous. It originated spontaneously in the ferneries of Earl Fitzwilliam at Wentworth House, England. Asplenium pinnatifidum (Nuttall) also bears considerable resemblance to A. ebenoides, but has a green herbaceous midrib or rachis, a sinuous-margined prolongation, thicker texture, and is very rarely, if indeed ever, proliferous.

Plate IV., Fig. 2.—A frond of Asplenium ebenoides, the segments less elongated than usual.

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#### PLATE V. - Fig. r.

# BOTRYCHIUM LUNARIA, SWARTZ.

#### Moonwort.

BOTRYCHIUM LUNARIA: — Plant smooth, fleshy, commonly four to ten inches high; sterile segment sessile near the middle of the plant, oblong, rarely ovate, obtuse, pinnately cleft; lobes or pinnæ semi-lunar from a broadly cuneate base, the sides concave, the outer margin rounded, entire or obscurely crenulate, rarely incised; veins flabellately forking; fertile segment twice to thrice pinnate.

Botrychium Lunaria, Swartz, in Schrad. Journ. Bot., 1800, ii., p. 110; Syn. Fil., p. 171. — Schkuhr, Krypt. Gew., p. 156, t. 154. — Willdenow, Sp. Pl., v., p. 61. — Moore, Nat. Pr. Brit. Ferns, t. 51, A. — Ноокег, Flor. Bor. Am., ii., p. 265; Brit. Ferns, t. 48. — Мідре, Nov. Act. Acad. Nat. Cur., xxvi., pars ii., p. 657, t. 47, 48; Fil. Eur. et Atl., p. 192; Botr. Monogr., p. 101. — Елтол, in Gray's Manual, ed. v., p. 671.

Osmunda Lunaria, LINNÆUS, Sp. Pl., p. 1519.

HAB. — Dry elevated pastures and waste lands, from within the Arctic Circle to Labrador, Newfoundland, Canada, New York, Lake Superior, and the Rocky Mountains. Colorado, Dr. PARRY. Europe, Asia, Australia, and Tierra del Fuego.

Description. — The moonwort, and all other species of Botrychium, have a short, fleshy, nearly erect, cordlike rhizoma,

and irregular, mostly simple, spreading roots, both containing starch in abundance. Commonly but a single frond is produced each year. This frond, in all the species, consists of a common stalk, a posterior sterile segment, and an anterior fertile segment. The base of the stalk is enlarged, and encloses in a rudimentary condition the fronds for the next year or two. In the position of these rudiments, and in their development, a law of alternation has been observed; that is, the sterile segment for one year occupies the position held by the fertile segment of the preceding year, so that a longitudinal section of the bud contained in the base of the stalk will show the rudiments for two or even three years packed closely away, and with the fertile and sterile segments placed below each other alternately to right and to left. In B. Virginianum, the very base of the stalk is split open on one side, more or less disclosing the bud; but in all the other species there is no such cleft, and the bud is completely enclosed. There is generally also present a loose outer, sheath-like covering, which is the withered base of the stalk of the preceding year.

Botrychium Lunaria varies in total height from an inch and a half to a foot; but the greater part of specimens examined measure from six to nine inches long. Of this length, about a half—sometimes a little more or a little less than a half—is taken up by the common stalk, which is erect, smooth, terete, and fleshy. The sterile segment is almost always closely sessile, and commonly from a fourth to a third part of the whole length of the plant, or from one and a half to three inches long. It is oblong and obtuse in outline, fleshy, and divided into from two to nine

(usually four to seven) pairs of nearly opposite divisions, besides a smaller (usually two- or three- lobed) terminal division. These divisions have a broad wedge-shaped base, but rapidly widen out on both the upper and lower sides, and have the outer margin rounded, so that they are more or less clearly moon-shaped: whence the common name of the plant. The outer margin is either entire, crenulate, or incised; sometimes deeply so, as in var. incisum of Milde. In var. tripartitum (Moore, Nat. Print. Brit. Ferns, 8° ed., p. 324) the two lowest divisions are elongated and pinnately parted, rendering the whole sterile segment ternate. The venation is essentially flabellately dichotomous. A single vascular bundle proceeds from the midrib of the sterile segment to each division: this vascular bundle or vein forks once at the very base of the division, and its two branches again where the division begins to widen, and these veinlets again three or four times before the outer margin is reached. The fertile segment is long-peduncled, and usually overtops the sterile segment considerably. It is twice or thrice pinnately compound, forming a panicle not unlike a miniature cluster of grapes; and from this resemblance the genus takes its name of Botrychium, or Grape-fern. The spore-cases are globular, about half a line in diameter, and open transversely into two equal valves. Their texture is subcoriaceous, and no vestige of a ring can be observed. The sporecases of all the species of the genus are essentially alike in all respects. The spores are pale or colorless, roundish-tetrahedral, having the general surface minutely roughened or granular, but with the three straighter edges marked by a smooth band. The plant is of course perennial, though only to be found during the spring and summer, as it is mature (in England certainly) in July, and soon afterwards withers away.

My finest American specimens are from Nipigon Bay, Lake Superior, collected by Mr. J. Macoun, and presented to me, together with others from various places in Canada, by Mr. Watt of Montreal. The Nipigon-Bay plants are finer and larger than the average European specimens, being fully nine inches long, the sterile segment with five pairs of ample pinnæ, and the fruiting one fully tripinnate. The Colorado plants are small, but clearly of this species. In the Bulletin of the Torrey Botanical Club for October, 1877, Mr. George E. Davenport announces the discovery of the moonwort near Syracuse, N.Y., by Miss Jane Hosmer, Mr. E. W. Munday, and Mrs. Stiles M. Rust, and describes a remarkable form with very distant, alternate, rounded lobes. Mr. Davenport has favored me with one of the Syracuse specimens, and with drawings of some of the others.

The moonwort was anciently employed in alchemy and magic; and, until a comparatively recent period, it was considered "singular to heal green and fresh wounds." But its virtues were never rightly manifested unless the plant was collected by moonlight,—probably not an easy task.

Plate V., Fig. 1.— *Botrychium Lunaria*, a plant of medium size, much like one of the Labrador specimens. The cluster of sporangia also belongs to this species; though in respect to the sporangia there is little difference between several of the species of this genus.

#### PLATE V. - Fig. 2.

# BOTRYCHIUM LANCEOLATUM, ANGSTRÖM.

### Lanceolate Grape-Fern.

BOTRYCHIUM LANCEOLATUM: — Plant two to eight inches high, scarcely fleshy; the common stalk slender, and bearing high up, near the short-stalked fruiting panicle, a sessile deltoid membranaceous once or twice pinnatifid sterile segment; divisions few, oblique or somewhat spreading, oblong-lanceolate, straight, acute, the base narrowed and decurrent; lowest pair much the longest; veins forking from a mid-vein; fertile panicle with slender branches and seldom crowded sporangia.

- Botrychium lanceolatum, Angström, "Botaniska Notiser, 1854, p. 68; 1866, pp. 36, 37." Мідде, Nov. Acad., Acad. Nat. Cur., xxvi., pars ii., p. 674, t. 51, f. 178–181; Fil. Eur. et. Atl., p. 197; Monogr. Botr., p. 132, t. 8, f. I (venation). Елтон, in Gray's Manual, ed. v., p. 671.
- Osmurda lanceolata, GMELIN, "in Nov. Comment. Acad. Petrop, xii. (1768), p. 516, t. 11, f. 1."
- Botrychium rutaceum, var. lanceolatum, Moore, Ind. Fil., p. 211. (For additional synonymy, consult Milde's papers above cited.)

Hab. — Along mossy stream-banks and in moist pastures, from New Brunswick, Rev. J. Fowler; to Colorado, Brandegee. Near Bethlehem, New Hampshire, Miss C. C. Haskell. Goshen, Massachusetts, Rev. H. G. Jesup. Orange, Connecticut, Oscar Harger. Near Utica and Syracuse,

New York, Edwin Hunt, Mrs. Dr. Barnes, Mrs. Rust, etc. Dutchess County, New York, L. H. Hoysradt. Southern New York and New Jersey, C. F. Austin. Susquehanna County, Pennsylvania, A. P. Garber. Cleveland, Ohio, *fide Milde*. Lake Superior, H. Gillman. Also in Unalaska, Northern Europe and Siberia.

DESCRIPTION. — This fern is usually about five to seven inches high; small specimens being sometimes only two or three inches high, and very large ones attaining the height of eight or nine inches. The common stalk is more than four-fifths of the whole height of the plant, so that the sterile and the fruiting segments are borne close together on the top of a slender common stalk. This stem or stalk is moderately fleshy, from half a line to a line and a half thick, and considerably swollen at the base, where it encloses the bud for the fronds for the next year or two. The sterile segment in full-sized plants is closely sessile and broadly triangular in form, measuring an inch in width, and scarcely more than an inch in length. There are about four pairs of pinnæ or side-divisions, all set on obliquely; the lowest ones decidedly largest, ovate-lanceolate in shape, sub-acute at the apex, the sides cut about half-way to the mid-vein into little obliquelyplaced ovate-oblong lobes, and the base gradually narrowed, but attached to the central rachis by a manifest wing. The second and third pairs of lateral divisions are successively smaller, and are also lobed or toothed, but less so than the lowest pair. There is sometimes a fourth pair of short, slightly-toothed divisions, and then the rhomboid-ovate apex, which is moderately acute, and either slightly toothed or entire. In very small specimens there

are only two or three pairs of side-divisions, and these are oblonglanceolate and nearly entire, the lowest pair longest, as in more fully developed plants.

There is a single central vein in the main rachis, and this sends off a branch to each lateral division, and from these branches in turn a veinlet extends to each lobe. If the lobes are toothed, there is a smaller veinlet extending to each tooth. Every vein or veinlet leaves its parent-vein some distance below the base of the division or lobe to which it runs; so that below each pair of pinnæ there will be seen in the rachis a central vein and two gradually diverging lateral veins; but these branch-veins unite with the central vein about opposite the upper side of the base of the next lower pair of side-divisions.

The fruiting segment has a stalk from three to nine lines long, and is usually a little longer than the sterile segment. It is usually twice pinnate, the lower pinnæ or branches nearly erect or slightly spreading, and nearly as long as the middle portion. All the branches and branchlets are more elongated than in the other small *Botrychia*, and the sporangia are rather distantly placed; so that the whole panicle is seldom dense, but comparatively lax and sparingly fruited.

As in the other species of the genus, it not unfrequently happens that some portion of the sterile segment will be much contracted, and bear a few sporangia. The whole plant is perfectly smooth, and much less fleshy than *B. Lunaria* or *B. ternatum*.

Very young plants of this species are not easily distin-

guished from young plants of *B. matricariæfolium*; and, indeed, small specimens of both these species were formerly confounded with *B. simplex*. In the "Synopsis Filicum" this is considered a variety of *B. rutaceum* [= *B. matricariæfolium*], but the very careful and pains-taking studies of Dr. Milde show them to be both well-marked and distinct species; and this view is confirmed by a close inspection of the very numerous specimens of both species which I have received from numerous correspondents in New England, New York, British America, and Colorado. The differences between the two species will be carefully pointed out when *B. matricariæfolium* comes to be figured and described in a later portion of this work.

B. lanceolatum grows chiefly in damp mossy places along shaded rills, but sometimes on moist hill-side pastures. My first specimens were collected near Tappantown, New York, in 1857, by Mr. Coe F. Austin. The sporangia are ripe in New York about the middle of July.

The drawing, Plate V., Fig. 2, represents a plant of *Botrychium lance-olatum* of full size: occasionally the habit is a little stouter and more condensed.

# PLATE V. - Fig. 3.

# BOTRYCHIUM BOREALE, MILDE.

## Northern Grape-Fern.

BOTRYCHIUM BOREALE: — Plant two and a half to seven inches high, smooth; the sterile segment dark green, fleshy, placed considerably above the middle of the plant, sessile, cordate-ovate or somewhat triangular in outline, pinnately cleft to a narrow rachis; pairs of divisions two to four, closely placed, sometimes overlapping, the lowest ones rounded-ovate from a narrow base, cut half-way down into two to four broad obtuse lobes; upper divisions successively smaller, entire or slightly lobed; veins flabellately forking; fertile panicle with a stalk about as long as the sterile segment, twice or thrice pinnate, the sporangia crowded.

Botrychium boreale, MILDE, Botanische Zeitung, xv. (1857), p. 880; Nova Acta Acad. Nat. Cur., xxvi., pars ii., p. 672, t. 51, fig. 175–177; Id. p. 757, t. 55, figs. 1, 2; Fil. Eur. et Atl., p. 194; Botr. Monogr., p. 118.

Botrychium Lunaria, var. 4, Kaulfuss, Enum. Fil., p. 25. Botrychium Lunaria, var. boreale, Fries, Herb. Normale, xvi., 85.

HAB. — Unalaska, Chamisso. Sweden and Norway, Lapland, Finland and Eastern Siberia.

Description. — The Northern grape-fern has scarcely a

place in our flora, having been collected within our territorial limits but once, and that sixty years ago by the distinguished naturalist and poet, ADELBERT VON CHAMISSO.

The plant is commonly of smaller stature than the other species figured on Plate V.; and the common stalk is long for the size of the plant, so that the sterile and the fertile portions of the frond are borne near each other, as in B. lanceolatum and B. matricariæfolium. The sterile segment is closely sessile, broadly ovate or somewhat triangular in shape, but subcordate at the base. The divisions are broad and foliaceous, and placed so closely that they are often imbricating or overlapping. The lowest divisions are nearly as broad as they are long, and are in shape rhomboid-ovate, with rounded contours. They are cleft nearly half-way to the base into a few lobes which are rounded at the ends. The succeeding divisions are similar in shape, but are gradually smaller and less lobed; the terminal portion scarcely acute, and about three-lobed. The length of the sterile segment is an inch or a little less in several specimens from Dovrefield and Westrobothnia, and the breadth at the base is about fourfifths of the length. The vascular bundle is already separated into two or three veins when it enters the base of the lateral divisions, and these veins are repeatedly forked, so as to be flabellately dichotomous. Milde says, "Nervatio cyclopteridis."

The fruiting segment is borne on a stalk rising from the base of the sterile segment, and about equal to it in length: the panicle itself is rather scanty in my specimens, but more generous in some of those figured by Milde; and the sporangia are so dense

as to be fairly contiguous. Dr. Milde figures some specimens decidedly larger, and with more numerous lobes than those I have seen; and in several instances the sterile segment is represented as producing a few sporangia.

The thickish fleshy frond, and the flabellate venation of the broader and more rounded pinnæ, will serve to distinguish this fern from *B. lanceolatum*, if it should be found again in North America; while the whole shape and details of the sterile segment will prevent any confounding of it with the commoner moonwort.

Mr. George E. Davenport has recently been making a special study of the smaller species of *Botrychium*, and informs me that he finds some good specific distinctions in the character of the buds. His contributions to the literature of this genus will be read with great interest. Dr. Milde only notices the peculiarity in the bud of *B. Virginianum* referred to in a preceding page, and uses the character of "buds pilose" and "buds never pilose" to some extent in separating the remaining species.

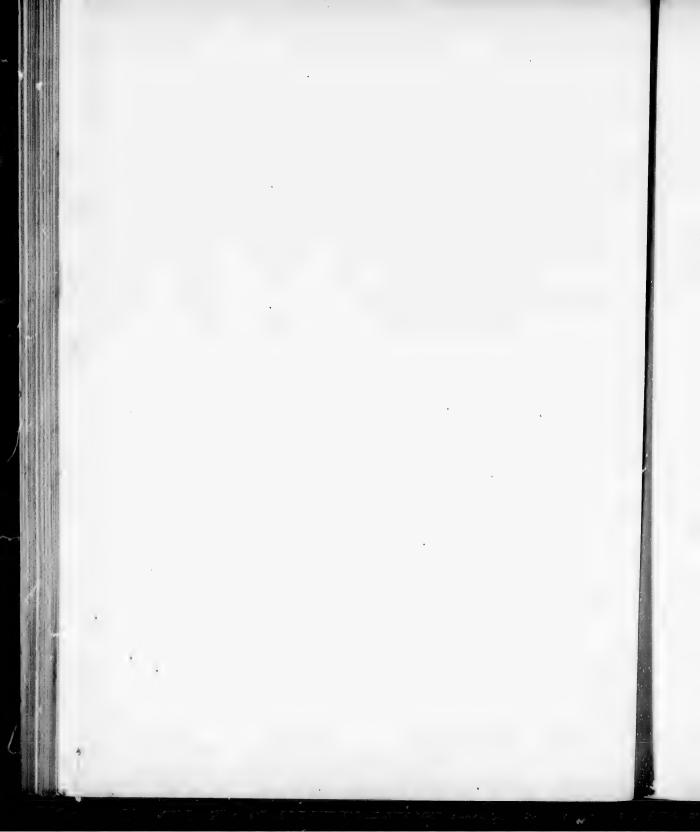
Plate V., Fig. 3, represents a plant of medium size: the specimen drawn is from Sweden, and is preserved in the collection of Mr. Davenport.







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## PLATE VI. - Fig. 1.

# CHEILANTHES LANUGINOSA, NUTTALL.

## Woolly Lip-Fern.

Cheilanthes lanuginosa:—Stalks densely tufted, slender, brownish-black, at first clothed with spreading woolly hairs, at length nearly smooth; fronds two to four inches long, one to one and a half broad, ovate-lanceolate, tripinnate, or bipinnate with crenately pinnatifid pinnules; pinnæ varying from deltoid to oblong-ovate, the lowest ones distant, the upper ones gradually closer; the ultimate pinnules minute, not more than half a line long and broad, or the terminal one more obovate and a little longer,—all very much crowded; upper surface scantily tomentose, the lower densely matted with soft whitish-brown distinctly-articulated flattened woolly hairs; involucres very narrow, formed of the unchanged herbaceous margin of the segments.

Cheilanthes lanuginosa, Nuttall, MS. in herb. Hooker!, and in Hooker, Sp. Fil., ii., p. 99 (where it is wrongly quoted as a synonym of Ch. vestita). — D. C. EATON, in Gray's Manual, Mar. 1863, Addenda, p. ci.; ed. v., p. 659. — Hooker & Baker, Syn. Fil., p. 139.

Cheilanthes vestita, Hooker, Sp. Fil., l. c., excl. syn., t. 108, B. — Gray, Manual, ed. i., ii., iii., not of Swartz, and Willdenow.

Cheilanthes lanosa, D. C. EATON, in Botany of Mexican Boundary, p. 234, not Nephrodium lanosum, Michx.

Cheilanthes gracilis, METTENIUS, über Cheilanthes, p. 36.

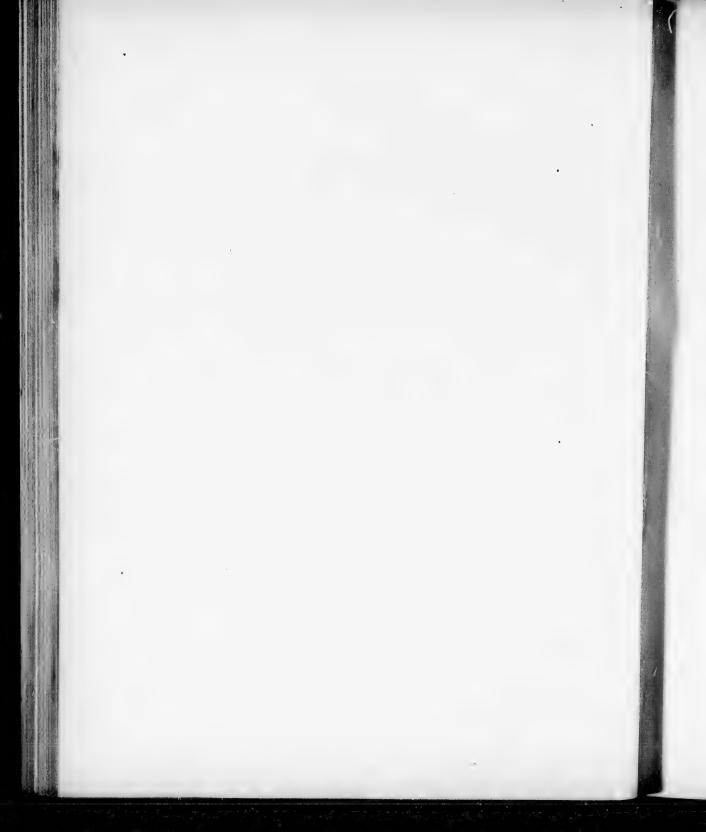
Myriopteris gracilis, Fée, Gen. Fil., p. 150, t. 29, fig. 6.

HAB.—In the United States from Illinois and Wisconsin to Utah, Colorado, New Mexico, and Arizona. In British America, collected by BOURGEAU at the eastern base of the Rocky Mountains, near lat. 51°. Fort Independence, Mo., NUTTALL! It grows in dense tufts on dry exposed rocks and cliffs.

DESCRIPTION. - Root-stocks rather short, creeping, forming a matted mass; the chaff narrow and somewhat crisped, deep cinnamon-brown, with a blackened midrib; fronds densely clustered, two to four inches long, or sometimes very much smaller; stalks about as long as the frond, very slender, wiry, but rather fragile, very dark brown or almost black, scantily furnished with spreading, pale-fulvous, jointed hairs. In the larger specimens the fronds are fully tripinnate; the pinnæ triangular and opposite at the base of the frond, but towards the apex gradually become ovate, and are alternate and crowded. The ultimate pinnules are very much crowded, very minute, - scarcely half a line in diameter, - rounded, or slightly obovate; the terminal ones rather larger, and obscurely lobed. The upper surface is scantily provided with whitish webby hairs; the lower surface heavily covered and obscured with pale-fulvous matted wool, the fibres of which are flattened and plainly articulated. The involucres can be seen only by carefully removing the wool, and are then found to be almost continuous round the lobule, and formed of its scarcely changed herbaceous margin. The general color of the plant is of a pale grayish-green, intermingled with light brown.

This fern was originally discovered in Missouri by Thomas Nuttall; and his specimens, with his manuscript name, are preserved in the Hookerian herbarium. In writing the "Species Filicum," Sir W. J. Hooker seems to have confounded it with *Ch. vestita* of Swartz; but his description and figure apply to the present plant. Dr. Fée's figure is also characteristic, though representing a specimen not so large as we commonly see. Those persons who call the plant *Cheilanthes gracilis* (Richl) are only perpetuating an error, or *lapsus calami*, of Mettenius in quoting Fée; for Fée says plainly, "*Cheilant'es vestita* (Richl, *non* Sw.), No. 529."

Plate VI., Fig. 2. — *Cheilanthes lanuginosa*, of natural size, with a small portion considerably enlarged, the woolly hairs removed to show the narrow involucre.



### PLATE VI. - Fig. 2.

# CHEILANTHES CALIFORNICA, METTENIUS.

#### Californian Lip-Fern.

Cheilanthes Californica:—Stalks densely tufted, dark brown, glossy, four to eight inches long; frond somewhat shorter, smooth and green on both surfaces, broadly deltoid-ovate, delicately quadripinnatifid,—i.e., the upper portion of the main rachis and all its divisions with a narrow herbaceous wing or border; lowest pinnæ much the largest, triangular-ovate, more developed on the lower side; upper pinnæ gradually smaller and simpler; ultimate pinnules lanceolate, very acute, incised or serrate, and, when fruiting, with usually separate crescent-shaped membranaceous involucres in the sinuses between the teeth, which also are often at length recurved.

Cheilanthes Californica, METTENIUS, über Cheilanthes, p. 44.

Hypolepis Californica, Ноокег, Sp. Fil., ii., p. 71, t. 88, A.— Ноокег & Вакег, Syn. Fil., p. 131.

Aspidotis Californica, NUTTALL, MS. in herb. Hook. - Hook., Sp. Fil., l. c.

HAB. — In moist and shady ravines and cañons; known only from the coast ranges of the southern part of California, and from Sonora in Mexico.

Description. — Root-stocks short, creeping, very chaffy, with rather rigid, namow, dark-brown scales; stalks chestnut-brown, smooth and shining, usually about six to eight inches long, and

erect, or nearly so; fronds smooth and green, herbaceous, mostly about three or four inches long and three-fourths as broad, triangular-ovate in outline, quadripinnatifid, — i.e., four times pinnate, but with a very narrow wing bordering the divisions of the rachis, as well as the upper half of the main rachis. The glossy-brown appearance of the stalk continues some distance up the rachis and its divisions, especially on the under surface. The two lowest pinnæ are opposite, and very much larger and broader than the others. They are much broader on the inferior than on the superior side, the lowest inferior secondary pinna being about one-third as long as the rest of the whole frond. The quaternary or smallest divisions are two or three lines long, rather less than a line broad, and are lanceolate and very acute. They bear two or three acute teeth on each side, and in the fruiting-frond a delicate, whitish, crescent-shaped involucre sweeps from the apex of each tooth half way up the side of the next tooth above; but sometimes one involucre runs into the next. When the sporangia ripen, the teeth are usually reflexed partly over the sorus.

This very pretty and delicate little fern reminds one, by its general habit, of the still rarer *Cystopteris montana*. The frond, however, is of rather firmer texture, and is still more finely divided. There is no other North-American fern which it resembles even slightly. It was formerly very rare in collections, but of recent years has been liberally distributed by the botanists of Santa Barbara, where it seems to be reasonably common.

It certainly has nothing in common with the recognized species of *Hypolepis*, a genus of large ferns, which is, perhaps,

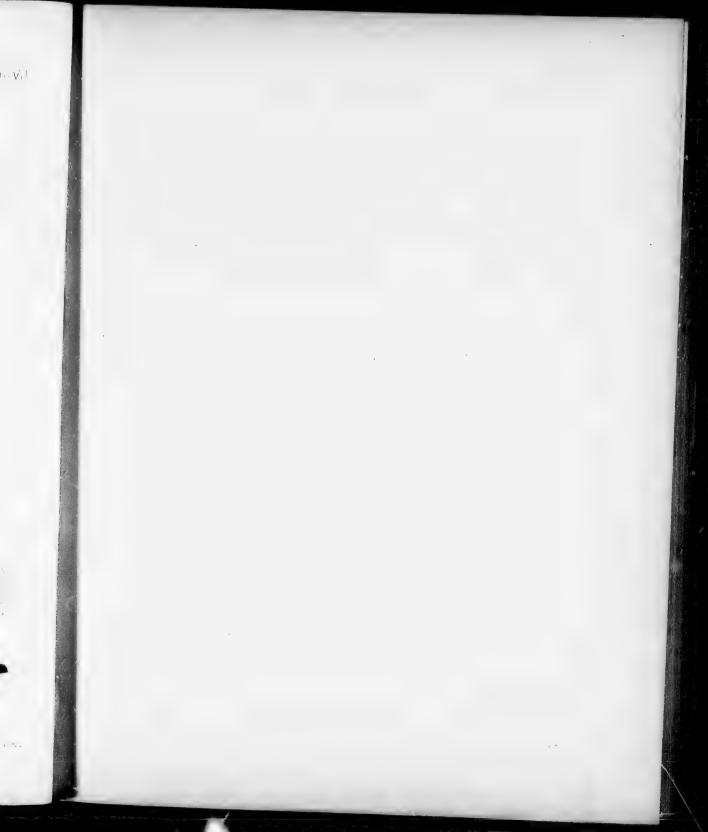
best arranged with the Aspidiea. Cheilanthes Schimperi (Kunze), from Abyssinia, and Ch. incisa (Kunze), from Brazil, are its nearest allies; and the three form a good subordinate group of the sub-genus Adiantopsis.

The figure represents a fully-developed frond, quite as large as one often sees, and a small portion of a fertile segment, the latter much enlarged, and showing well the peculiar lunately-curved involucre.









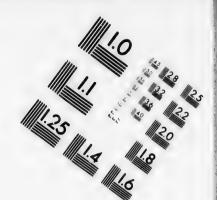
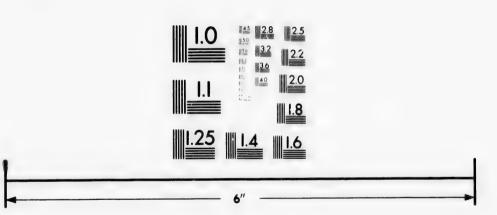


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#### PLATE VII.

# ASPIDIUM NOVEBORACENSE, SWARTZ.

#### New-York Shield-Fern.

ASPIDIUM NOVEBORACENSE:—Root-stock elongated, creeping, cord-like; stalks about one-third the length of the fronds, slender, at first sparingly chaffy, soon naked; fronds one to two feet long, thin-membranaceous, minutely ciliate and finely hairy along the midribs and veins, especially beneath, lanceolate in outline, with an acuminate apex and a gradually narrowed base, pinnate; pinnæ sessile, lanceolate, acuminate, deeply pinnatifid, the lower four to six pairs gradually shorter and deflexed, the lowest mere auricles; lobes crowded, flat, oblong, obtuse, entire, basal ones occasionally enlarged and toothed; veins free, pinnate from the mid-vein, straight, simple, rarely a few of them forked; sori minute, placed near the margin; indusium reniform, glandular, and sometimes with scattered hairs, delicate and withering as the fruit ripens.

Aspidium Noveboracense, Swartz, Syn. Fil., p. 55. — Schruhe, Krypt. Gew., p. 47, t. 46. — Willdenow, Sp. Pl., v., p. 248. — Kunze, in Silliman's Journ., 1848, vi., p. 83. — Mettenius, über Aspidium, p. 78. — Torrey, Flora of New York, ii., p. 497. — Grav, Manual, ed. ii., p. 597, et ed. omn. seq. — Eaton, in Chapman's Flora of the Southern United States, p. 594.

Polypodium Noveboracense, LINNÆUS, Sp. Pl., p. 1552.

Dryopteris Noveboracensis, GRAY, Manual, ed. i., p. 630. — DARLINGTON, Flora Cestrica, ed. iii., p. 396.

Nephrodium Noveboracense, Desvaux, Mém. Soc. Linn. (Paris), vi., p. 257.

— Ноокег, Sp. Fil., iv., p. 89.— Ноокег & Baker, Syn. Fil., p. 267.

Lastrea Noveboracensis, PRESL, Tent. Pterid., p. 75.— J. SMITH, Ferns, British and Foreign, p. 153.

Nephrodium thelypterioides, MICHAUX, Flor. Bor. Am., ii., p. 267.

Aspidium thelypterioides, SWARTZ, Syn. Fil., p. 57.

Aspidium Thelypteris, HOOKER, Flor. Bor. Am., ii., p. 260; not of Swartz.

Var. SUAVEOLENS:—Fronds narrower, slightly more rigid, very sweet-scented in drying; the under surface copiously sprinkled with minute glands.

HAB.—In moist thickets and wet grassy places from New Brunswick, Rev. J. Fowler; and Canada to Virginia, Curtiss. Also reported from Ohio, Kentucky, North Carolina, and westward to Michigan and Wisconsin; but I have seen no specimens from those States. The variety was discovered in Essex County, New York, and again near Glens Falls, by Mrs. Lucy A. MILLINGTON.

Description.—The root-stock of this fern is very slender, scarcely two lines thick, and creeps just beneath the surface of the ground several inches in advance of the growing fronds. The newest portion is sometimes downy with fine yellowish wool, and bears a few chaffy scales, which soon disappear. The older part of the root-stock is more or less furrowed, and produces slender branching roots. A transverse section cut at a distance from the base of the stalks is irregular in shape, and consists of an outside

layer of hard dark-brown cells (sclerenchyma of Mettenius and Sachs), and an interior mass of soft white parenchyma, through which there extend variously shaped threads and bands of fibrovascular tissue, and at least one larger band of sclerenchyma also. A section near the insertion of one of the stalks will show outside of the cortical sclerenchyma a smaller mass of parenchyma traversed by one or two little fibro-vascular threads, and a scanty covering of sclerenchyma again outside of all. Very few of our ferns have been carefully studied with reference to the anatomy of the root-stock, and I may say that in this direction there lies a broad and interesting field for investigation.

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The stalks which are to bear fronds in the year to come form little stems near the growing extremity of the root-stock. The stalks which support the fronds of the present year are few in number (two to four), and stand either close together, or some lines apart, but always at some considerable distance from the end of the root-stock. The stalks are commonly from four to six inches high, slender, brownish straw-color; and only when very young are they furnished with a few little chaffy scales near the base.

The fronds are from one to two feet long, and from three to six inches broad. In outline they are lanceolate, tapering upward to an acuminate and slender apex, and gradually contracted from the middle downwards to a very narrow base. The pinnæ are from one and a half to three inches long, lanceolate, sometimes slightly narrowed but more often a little enlarged at the base, pinnatifid almost to the midrib, and with the apex slenderly acuminate. Sometimes the pinnæ diverge from the rachis by an angle

of sixty degrees; but more frequently they spread out nearly at right angles with it. The lower pinnæ are gradually more distant than the middle ones, and are shorter and more deflexed towards the base of the frond, so that the very lowest ones are often not more than two lines long. The lobes or segments of the pinnæ are flat, slightly oblique, oblong, rounded-obtuse, and entire or slightly toothed. The lowest segments of each pinna arise from the very base of its midrib, so that the pinnæ are absolutely sessile on the main rachis. These lowest segments are sometimes a little shorter than the higher ones; but in other specimens they are found rather larger than the rest, and more decidedly toothed.

The venation is free: each lobe has a central mid-vein, and on each side of this about six or seven pinnately arranged veinlets. These leave the mid-vein at an angle of about forty-five degrees, and run straight to the margin of the lobes. They are normally simple; but in fronds with enlarged and toothed basal lobes they are sometimes forked, or the lowest vein of several lobes may be forked. The texture of the fronds is thin, so that they wither quickly when gathered, and die at the first approach of cold weather. The rachis, midribs, veins and veinlets, especially along the lower surface of the frond, are minutely pubescent with straight whitish hairs, and the lobes are ciliate with hairs of the same kind.

The sori or fruit-dots are much smaller than they are in some of the other common *Aspidia*. They are seated one on the back of each veinlet, nearer the margin of the lobe than the mid-

rib, and are almost always distinct. The fruit, when it is present at all, usually occupies the whole of the fruiting frond, which, as in most ferns, is rather narrower than the sterile frond, and has narrower divisions. The indusia are reniform and attached by the sinus, and very delicate. The cellules are irregular in shape, and may be called roundish-polygonal. The margin is bordered with minute yellowish globules, or glands; and sometimes a few occur on the surface also. Besides the glands, the indusia often bear a few short and straight whitish hairs. Schkuhr's figure, quoted above, gives an excellent representation of the indusium. The spores are ovoid-reniform, very much the shape of a kidneybean, but with a muricate surface and more or less of a semi-transparent border or wing along the slightly hollowed side.

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The sweet-scented variety has been noticed by Mrs. Millington for several successive years. It differs little from the common form. The specimens sent me are narrower and more rigid. The glands with which they are sprinkled on the under surface are nearly black in the dried plant, and the indusium is more permanent. Mrs. Millington writes that "a few plants dried in the open air will perfume a room deliciously for a long time." My specimens, gathered in 1873, are still pleasantly fragrant.

This fern has been confused at times with Aspidium Thelypteris. In the "Flora Boreali-Americana" Sir W. J. Hooker united the two; and many years later, in writing the account of this species for the "Species Filicum," he appears to have still entertained doubts as to its distinctness. But the only specimens in his herbarium at that time were imperfect fronds from Canada,

and one from Dr. Torrey with the lower part of the frond missing!

Aspidium Thelypteris is sometimes found with most of the veinlets simple, and the lower pinnæ a little contracted, so that it is perhaps well to indicate some of the most important distinctions in parallel columns.

#### A. NOVEBORACENSE.

Stalk shorter than the frond.

Frond with a long and slender apex, and much contracted at the base.

Pinnæ closely sessile.

Lobes flat.

Veinlets mostly simple. Sori near the margin.

Spores slightly wing-margined.

#### A. THELYPTERIS.

Stalk often longer than the frond.

Frond short-pointed; the base but little contracted, if at all.

Pinnæ with a very short but evident

stalk.

Fruiting lobes oftenest slightly reflexed over the sori.

Veinlets commonly forked.

Sori midway between mid-vein and margin, or nearer the mid-vein.

Spores wingless.

The specimen of *Polypodium Noveboracense* in the Linnæan herbarium lacks the lower part of the frond, but has simple veinlets, and is slightly pubescent; so that there is little doubt of its being the present species.

Mr. Emerton has drawn a plant of ordinary size: the long creeping root-stock is very characteristic. A portion of a pinna, enlarged, shows the venation and the position of the sori; and the indusium, highly magnified, shows the marginal glands and the hairs.

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### PLATE VIII. - Fig. 1.

# CAMPTOSORUS RHIZOPHYLLUS, LINK.

### Walking-Leaf.

CAMPTOSORUS RHIZOPHYLLUS: — Root-stock short, creeping or ascending; stalks tufted, slender, flaccid, green, but becoming brown near the base; fronds a few inches to a foot long, sub-coriaceous, evergreen, smooth, gradually narrowed from a deeply cordate and auricled base to a long and very slender prolongation, decumbent and often rooting at the end; veins reticulated near the midrib, and having free apices along the margin; sori elongated, variously placed on either side of the veins, often face to face in pairs, or extending around the upper part of the meshes; indusium delicate.

- Camptosorus rhizophyllus, Link, Hort. Berol., ii., p. 69; Fil. Sp. Hort. Berol., p. 83. Presl, Tent. Pterid., p. 121, t. 4, fig. 8. Hooker, Gen. Fil., t. 57, C; Fil. Exot., t. 85. Gray, Manual. Darlington, Flora Cestr., ed. iii., p. 393. Mettenius, Fil. Hort. Lips., p. 67, t. 5, fig. 6.
- Asplenium rhizophyllum, Linnæus, Sp. Pl., p. 1536. Swartz, Syn. Fil., p. 74. Wildenow, Sp. Pl., v., p. 305. Michaux, Fl. Bor. Am., ii., p. 264. Bigelow, Fl. Boston.
- Antigramma rhizophylla, J. Smith, in Hook. Journ. Bot., iv., p. 176; Ferns, British and Foreign, p. 226.—Torrey, Fl. New York, ii., p. 494, t. 159 (Asplenium).

Scolopendrium rhizophyllum, Endlicher, Gen. Fl.. Suppl. i., p. 1348.— Hooker, Sp. Fil., iv., p. 4.— Hooker & Baker, Syn. Fil., p. 248

HAB.—On mossy rocks, especially limestone. Not uncommon from Canada to Virginia and Alabama, and westward to Wisconsin and Kansas. It occurs in many places in Western New England, but is rare to the east. It has lately been found a few miles from Boston; but there is a doubt whether the station is truly natural.

DESCRIPTION. — The walking-leaf is usually found in patches of considerable extent. It seems to prefer mossy calcareous rocks, and the finest specimens are usually firmly rooted in the crevices. In Cheshire, Connecticut, it grows freely on moist cliffs of sandstone bordering a deep ravine; and in Orange, in the same State, it is found on scattered ledges of serpentine. The root-stock is very short, but creeping: it bears a few dark-fuscous scales, and is covered with the remains of decayed stalks. A few fronds grow from the end of the root-stock, and are supported on slender herbaccous stems a few inches long. A transverse section of the lower part of the stalk is semicircular, and shows a very slender triangular central thread of dark sclerenchyma, with two somewhat roundish fibro-vascular bundles close beneath or behind it. A section higher up shows that the stalk is there narrowly winged on each side, and the two fibro-vascular bundles have coalesced into one of a roundish-triangular shape. The frond is long and narrow, and rarely rises erect, but usually is decumbent or reclined in position.

The wings of the stalk widen out into a wedge-shaped base, which is sunken in a sinus between two basal auricles of the

frond. These auricles are scantily developed in small fronds; but in larger ones they are more or less prominent, making the base of the frond either cordate or hastate. In specimens from Cheshire, Connecticut, and in some from Indiana, the auricles are drawn out into slender points, in one instance fully four inches long. The fronds are deep-green in color, and sub-coriaceous in texture. The fronds of mature plants are from six to twelve, or even fifteen, inches long; and their greatest width, measured just above the auricles, is about one-twelfth of the length, or from six to fifteen lines. The midrib is a little paler than the rest of the frond, and is rather prominent on the under surface. The margin of the frond is gently undulating or entire, rarely incised.1 The upper part of the frond is scarcely wider than the stalk, and commonly produces a proliferous bud at the apex, where it very frequently takes root, and develops a new plant. In this way a single plant in a favorable position will become a whole colony in a few years' time.

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The venation is peculiar, and the disposition of the sori depends mainly on the peculiarities of the venation. Dr. Endlicher's description of them is so clear, that it is well to repeat it here: "Veins anastomosing [i.e., reticulating] in two series of hexagonal areoles [meshes], the angles of the marginal areoles sending out free, simple or forked, veinlets. Sori linear, solitary in the costal areoles [those nearest the midrib] and on the marginal veinlets: the indusium of the latter free toward the margin

<sup>&</sup>lt;sup>1</sup> See the "Flora of New York" for some figures of laciniated and forking fronds.

of the frond; of the former, toward the costa. In the areoles of the second series the sori are opposite: the indusium of the lower one free toward the costa; of the other, in the opposite direction." To this it may be added, that in some of the areoles the two sori meet and are confluent at the outer angle of the areole; and in this case the two indusia are sometimes, though not always, united into one. The indusia of the areoles next the midrib are also often bent at an angle, and the two portions plainly united. It was from this condition of some of the sori that the genus was named *Camptosorus* (bent fruit-dot); and it is only on this peculiarity that the genus can be kept separate.

The indusium is thin and delicate, composed of sinuousmargined cellules, and is more or less wavy along the free edge. The spores are ovoid, and have a crenated pellucid wing-like margin.

Sir W. J. Hooker referred the *Camptosorus*, together with the species of *Antigramma*, and the very peculiar Mexican fern *Schaffneria*, to the genus *Scolopendrium*; making the distinctive character of the genus to rest on the sori being "in pairs, opposite to each other, one originating on the superior side of a veinlet, the other on the inferior side of the opposite veinlet or branch." In this he was essentially anticipated twenty years by Dr. Endlicher; to whom, however, *Schaffneria* was unknown.

It is by no means impossible that future botanists will refer all these species to the old Linnæan genus *Asplenium*; for it is now pretty generally admitted that differences in venation do not constitute valid generic distinctions, and a radicant bud on the frond is common in many undeniably genuine Asplenea: and since Diplazium, with double involucres placed back to back on the same vein, is inseparable from Asplenium, it is by no means impossible that Scolopendrium and Camptosorus should be thought to have no better claim to rank as genera.

Probably the earliest notice of the walking-leaf is in RAY's "Historia Plantarum," vol. ii., p. 1927, published in 1688. It is there called "Phyllitis parva saxatilis per summitates folii prolifera." Other early accounts may be found in the "Species Plantarum" of LINNÆUS and of WILLDENOW, and in the second edition of Gronovius's "Flora Virginica." In the latter work it may be seen that Gov. Colden long ago described the auricles as being "also often acuminate."

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fer is not the A second species, with membranaceous fronds acute at the base (C. Sibiricus), occurs in Northern Asia, but is apparently very rare.

Plate VIII., Fig. 1.— Camptosorus rhizophyllus. The specimens are of the form with acuminate auricles. A portion of a frond with rounded auricles is drawn about twice the natural size, to show the peculiar arrangement of the veins and sori.



#### PLATE VIII. -- Fig. 2.

# ASPLENIUM PINNATIFIDUM, NUTTALL.

### Pinnatifid Spleenwort.

ASPLENIUM PINNATIFIDUM: — Root-stock short, creeping, branched; stalks numerous, clustered, brownish near the base, green higher up; fronds six to nine inches high, herbaceous or sub-coriaceous, mostly erect, lanceolate-acuminate from a broad and sub-hastate base, pinnatifid; lower lobes roundish-ovate or rarely caudate, sometimes distinct, the margin crenated, the upper ones gradually smaller and more and more adnate to the winged midrib, the uppermost very short, and passing into the sinuous-margined long acumination of the frond; veins dichotomous or sub-pinnate and forking, free; sori few on the lower lobes, solitary on the uppermost, those next the midrib occasionally diplazioid.

- Asplenium pinnatifidum, NUTTALL, Genera of N. Amer. Plants, ii., p. 251.

   Kunze, in Sill. Journ., July, 1848, p. 85. Gray, Manual. —

  Eaton, in Chapman's Flora of Southern U. S., p. 592. Hooker,
  Icones Plantarum, t. 927; Sp. Fil., iii., p. 91. METTENIUS, Fil.
  Hort. Lips., p. 72, t. 10, figs. 1, 2; Asplenium, p. 126. Hooker
  & Baker, Syn. Fil., p. 194.
- Asplenium rhizophyllum, var. pinnatifidum, Muhlenberg, Catalogus Plant.

  Am. Sept., ed. ii., p. 102.—Barton, Compendium Floræ Philad.,
  ii., p. 210.—Eaton, Manual of Botany, ed. iii., p. 188, etc.—

  Torrey, Compendium, p. 383.

<sup>&</sup>lt;sup>1</sup> Prof. Amos Eaton, grandfather of the present writer. Eaton's "Manual of Botany" went through eight editions from 1817 to 1841.

HAB. — Discovered by Thomas Nuttall in crevices of rocks along the Schuylkill River, near Philadelphia; also found along the Wissahickon Creek in the same vicinity. Lancaster County, Pennsylvania, Prof. Thomas C. Porter. On moist cliffs of sandstone in the Cumberland Mountains, East Tennessee, Prof. F. H. Bradley. Hancock County, Alabama, Hon. T. M. Peters. Mine-la-Motte, Southern Missouri, on sandstone rocks, Dr. Engelmann.

Description. — The root-stocks of this little fern are creeping, branched and often entangled, and chaffy with narrow lanceacuminate dark-fuscous scales. The cellular structure of these scales is similar to that of the scales of A. ebeneum, the cells being oblong-rectangular, and arranged in straight longitudinal rows. The stalks are from two to four inches long, and slightly chaffy when young: they are brown and shining at the base, but green higher up, except that a narrow line of brown is continued up the under side of the stalk nearly or quite to the base of the frond. A section made near the lower extremity of the stalk is nearly semicircular, and discloses two roundish fibro-vascular bundles side by side near the middle, and a minute thread of sclerenchyma, or hard dark tissue, on the inner side of each bundle. A section just below the frond shows the two fibrovascular bundles united into one, and the angles of the stalk slightly extended, forming very narrow wing-like borders. The minute inner filaments of sclerenchyma are never continued far up the stalk, and are sometimes wanting altogether.

The frond is from three to six inches long, and usually half an inch to an inch broad at the base, from which the general outline tapers to a long and slender point, not so long as the prolongation of the walking-leaf, and very rarely, if ever, rooting at the apex.<sup>1</sup> The fronds are mostly erect, sub-coriaceous or firmly membranaceous, smooth above, but with a few minute setulose scales beneath, deeply pinnatifid in the lower and middle portion, and sinuately lobed above, the long terminal portion undulate on the margins. The midrib is broad and well defined: it is winged throughout its length; the wing narrow at the base of the frond, but constantly widening upwards.

The lobes are irregularly roundish-ovate, sinuate, crenate or slightly toothed; the lowest ones occasionally drawn out into an acuminate point an inch long. Most of the lobes are attached to the wing of the midrib by a broad base: the lower ones sometimes have a short stalk.

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half butThe veins are everywhere free: in the lower lobes, if these are acuminate, the veins are pinnately branched from a mid-vein; clsewhere they are forked or dichotomous. The sori are mostly single, though here and there one will be diplazioid, — most commonly the lowest one on the superior side of the lobe. The indusia are very delicate; and the free edge is directed toward the middle of the lobe, excepting the indusia of the sori nearest the midrib, and these open toward the midrib. The sori are usually very full of sporangia, and, when ripe, nearly cover the back of the frond: even the narrow acumination bears a sorus at each undulation of the margin. Spores ovoid-bean-shaped, with reticulating ridges and an irregular winged border.

<sup>&</sup>lt;sup>1</sup> I find one or two instances of a slight enlargement of the apex, as if there were an attempt to form a proliferous bud.

This is now admitted by all pteridologists to be a distinct species; though it was formerly confounded with the Camptosorus, from which it is clearly distinguished by the free veins, the mostly single indusia, and the usual absence of a proliferous bud at the apex of the frond. Some of the less compound and more attenuated forms of A. montanum come much nearer to it; but in its simplest form this other species always has the fronds fairly pinnate, and its more compound forms resemble the A. pinnatifidum very little.

I take occasion to express my thanks to Hon. Thomas M. Peters of Moulton, Alabama, who has sent me abundant and fine specimens of this fern and of other rare species which are found in the northern part of Alabama.

In Plate VIII., Fig. 2, Mr. Emerton has represented a portion of one of the Alabama plants, together with a part of a frond moderately enlarged, to show the venation and sori.

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### PLATE IX. - Fig. 1.

# NOTHOLÆNA FENDLERI, KUNZE.

### Fendler's Notholæna.

Notholæna Fendleri: — Root-stock short, creeping or assurgent, thickly covered with narrow light-brown chaffy scales; stalks numerous, tufted, wiry, dark-brown and polished; fronds two to four inches long, broadly deltoid-ovate, four or five times pinnate, the rachis and all its divisions flexuous and zigzag, divaricate and often entangled, brown and shining; primary, secondary, and tertiary pinnæ alternate; ultimate pinnules sometimes opposite, one or two lines long, obovate-oval and entire, or two-to three- lobed, the upper surface scantily and the under surface abundantly whitened with a waxy powder; sporangia seated on the upper portions of the veins, bursting through the ceraceous coating.

Notholæna Fendleri, Kunze, Die Farrnkraüter, il., p. 87, t. 136. — Hooker, Sp. Fil., v., p. 113. — Porter, Syn. Fl. Colorado, p. 153. — Eaton, Ferns of the South-West, ined.

Notholæna dealbata, Torrey, Pacif. R. Rep., iv., p. 160, not of Kunze.

Cincinalis Fendleri, Fée, Gen. Fil., p. 160.

Gymnogramme Fendleri, METTENIUS, Cheilanthes, p. 7.

HAB. — Clefts of exposed rocks, from the mountains of Colorado to Texas, New Mexico, and Arizona, many collectors.

Description. — The root-stock is rather stout, not more than one or two inches long, and is heavily clothed with narrow l rightbrown scales. The remains of old stalks still adhering to it considerably increase its apparent size. The stalks are commonly about four inches long, straight or slightly curved, wiry, darkbrown or almost black, and polished, though not so shining as the stalks of most species of Adiantum. The fronds are about as long as the stalk, and nearly as broad as they are long; so that the general outline is broadly triangular. They are pinnately decompound to the fourth and even to the fifth degree of sub-division, and bear at the ends of the ultimate branchlets very minute obovate or often two- or three- lobed pinnules, having the upper surface of a pale bluish-green, and the under surface covered with a dense white powder. The main rachis and its primary and secondary branches are singularly flexuous, being bent at an obtuse angle alternately to right and left, and bearing a branch or branchlet on the outer or convex side of each angle. From this habit it results that the branches are never opposite or in pairs, but almost uniformly alternate. It sometimes happens that the branchlet is nearly as large as the branch from which it springs; and then the method of division is dichotomous, or forking, rather than pinnate. The lowest pinna (for there is but one lowest, not a pair) and the next to the lowest have not infrequently two, three, or even four branchlets arising from the upper side before any are developed from the lower. This may perhaps arise from suppression of the branchlets of the inferior side, or from a twisting of the secondary midrib. It is most noticeable in the figures given

by Kunze, and in specimens collected in Arizona by Dr. Edward Palmer. These specimens are exaggerated examples of what Dr. Milde has called anadromy; while the plant from which Mr. Emerton has taken his drawing has the first branch of the lowest pinna placed on the inferior side, and is therefore catadromous. All the branches and branchlets are dark brown and smooth, like the stalk; and they are so much refracted and divaricating, that the several fronds of one plant are almost always much entangled, so that they are difficult to separate without injury.

The sporangia are comparatively few: they are placed on the upper part of the free veinlets, and appear as a row or narrow band of dark-brown particles breaking through the white powdery mass. This powdery mass is found in ferns of several different genera, — Notholæna, Cheilanthes, and Gymnogramme. It is either white, creamy, pale yellow or deep yellow, the color varying even in fronds of the same species. In one Notholæna from Natal the powder is even pinkish in color. The powdery species of each of these genera have been separated by various authors into special genera, named respectively Cincinalis, Aleuritopteris, and Ceropteris. But these genera have been rejected by the more

<sup>&</sup>lt;sup>1</sup> Milde, Fil. Europæ et Atlantidis, p. 8: "Segments of the second degree, especially at the base of the lamina, are commonly arranged according to a most distinct order, which arrangement is not rarely most useful in safely distinguishing related species. This arrangement is either anadromous or catadromous. Those segments of the second degree are called anadromous of which the first one is placed on the superior side of the segment of the first degree [primary pinna]: therefore those are catadromous of which the first one is observed on the lower side."

judicious systematists, as not resting on a character of sufficient importance. The learned Dr. Fée, in speaking of the colored powder, says, "L'exsudation jaune, blanche ou rose qui couvre la lame inférieure de toutes ces plantes, est de nature céracée, et cette sorte de cire végétale est soluble dans l'alcool et l'éther. Elle est produite par des glandes en massue, et présente sous le microscope l'aspect de petits filaments d'une ténuité extrême."

The genus Notholæna is closely related to both Cheilanthes and Gymnogramme. It comprises scaly, woolly, powdery, and naked-leaved species, just as Cheilanthes does, and is distinguished from that genus only by the absence of a proper involucre. Even in this character some of the species are ambiguous; and it must be observed that the careful Mettenius rejected the genus, referring some of the species to Cheilanthes, and some to Gymnogramme. Keyserling (Adiantum, p. 10) makes Notholæna a sub-genus of Cheilanthes, with the character "rhachis teres." Hooker and Baker keep the genus distinct, and it is perhaps most convenient to do so. Very few genera of ferns can be so absolutely defined as to leave no species of doubtful affinities or ambiguous position. The name of this genus is variously written Notholæna, Notochlæna, and Nothochlæna. I have retained Robert Brown's original orthography.

Plate IX., Fig. 1. — Notholæna Fendleri, drawn from very fine and unusually large specimens collected in Fremont County, Colorado, by Mr. T. S. Brandegee. The details show small portions of the frond considerably enlarged, the ceraceous mass abundant on the lower surface, and sparingly present on the upper.

#### PLATE IX. - Fig. 2.

## NOTHOLÆNA DEALBATA, KUNZE.

#### Whitened Notholæna.

Notholæna dealbata: — Root-stock very short, chaffy with narrow scales; stalks clustered, wiry, very slender, dark-brown or nearly black and shining, one to three inches long; fronds rather shorter than the stalks, triangular-ovate in outline, delicately three to four times pinnate; the rachises and branchlets capillary, and in color like the stalks; pinnæ and pinnules mostly opposite in pairs, the ultimate segments oval or obovate and entire, distinct or united by a narrow wing, scarcely one line long, glaucousgreen above, white-farinose beneath, often with the margins much rolled under; sporangia seated on the free veinlets.

Notholæna dealbata, Kunze, in Silliman's Journal, July, 1858, p. 82; Die Farrnkräuter, ii., p. 57, t. 124, fig. 1. — Ноокек, Sp. Fil., v., p. 113. — Ноокек & Вакек, Syn. Fil., p. 374. — Еатон, Ferns of the South-West, ined.

Notholæna pulchella, Kunze, in "Bot. Zeit., i., 1843, Sp. 633;" Linnæa, xvii., p. 567.

Cheilanthes dealbata, Pursh, Fl. Am. Sept., ii., p. 671.—Nuttall, Gen. N. Am. Plants, ii., p. 253.

Cincinalis dealbata, Fée, Gen. Fil., p. 160.

Gymnogramme dealbata, METTENIUS, Cheilanthes, p. 6.

HAB. - "In the crevices of rocks on the banks of the Missouri River,

about fifty miles above its confluence," Pursh, Nuttall. "Dry calcareous rocks, on their perpendicular faces, and chiefly where sheltered by the overhanging projections; rather common in Middle and Southern Kansas," E. Hall, Parry. Texas, Herb. Durand. New Mexico and Arizona, Parry, Rothrock, Mrs. Sumner.

Description. — This little fern is in many respects like the species last described. It has the same dense white ceraceous or farinose coating on the under surface of the pinnules: the frond is decompound, the pinnules equally minute, and very similar in shape. The stalks and rachises are perhaps more nearly black, and have a somewhat higher polish. The most evident distinctions are, however, (1) the smaller size and greater delicacy of the present species, and (2) the fact that in this fern the pinnæ and pinnules of every degree are opposite in pairs, or nearly opposite.

The ultimate pinnules are more generally entire than in the larger species, and have a stronger tendency to become revolute, or strongly rolled under from both margins.

The specimens from Missouri and Kansas are very delicate, the whole plant not more than four inches high, and the nearly black branchlets almost as fine as horse-hair. The specimens from Arizona collected by Dr. Parry are equally delicate; but those from the Sonoita Valley in Arizona, collected by Dr. Rothrock, and from Camp Bowie in South-western New Mexico, collected by Mrs. Sumner, are considerably larger, and with heavier stalks and rachises.

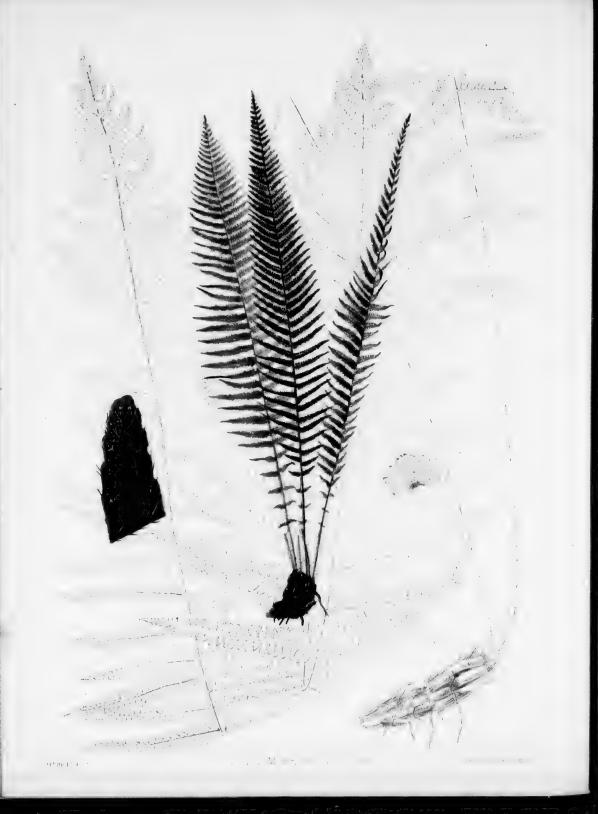
In the "Species Filicum" Sir William Hooker intimated that it is difficult to see how this plant is to be satisfactorily dis-

tinguished from *N. nivea*, a native of Tropical America; but the latter species is much coarser in every way, has longer and less compound fronds, far heavier stalks and rachises, and larger ultimate pinnules.

Plate IX., Fig. 2. — *Notholæna dealbata*, drawn from Mrs. Sumner's specimen, showing the under surface only.











#### PLATE X.

# ASPIDIUM NEVADENSE (N. SP.).

#### Sierra Shield-Fern.

ASPIDIUM NEVADENSE: — Root-stock rather short, creeping, densely covered with the persistent bases of former stalks; fronds standing in a crown, one and a half to three feet high, thin-membranaceous, lanceolate in outline, pinnate; pinnæ sessile, linear-lanceolate from a broad base, deeply pinnatifid, the lower pairs distant, and gradually reduced to mere auricles; lobes crowded, oblong, entire or sparingly toothed, slightly hairy on the veins beneath, and sprinkled with minute resinous particles; veins about seven pairs to a lobe, simple, or a few of the lower ones forked; sori close to the margin; indusium minute, reniform, furnished with a few dark-colored marginal glands, and bearing several long straight jointed hairs on the upper surface.

Aspidium Nevadense, EATON, Ferns of the South-West, ined.

HAB. — In moist meadows and along creeks in the Sierra Nevada of Northern California, especially in a meadow containing also the *Darlingtonia*, near Quincy, Plumas County, Mrs. R. M. Austin and Mrs. Pulsifer Ames; also in Berry Creek Cañon, Butte County, Mrs. Ames.

Description. — Except in the nature of the root-stock, and the consequent position of the fronds, standing in a crown, this fern has a very close resemblance to the New-York shield-fern.

The fronds are similarly short-stemmed; they are similarly lanceolate in outline, with an acuminate apex and a gradually narrowed base; the texture is much the same; the pinnæ and lobes very like those of the other species; and even in the disposition of the veinlets, and the character of the indusium, there is but very little difference. But while Aspidium Noveboracense has a long and slender cord-like rhizoma, which creeps far in advance of the position of the fronds, the present species has a short and somewhat stouter rhizoma, covered by the imbricated or overlapping bases of former stems; and the fronds, several in number, are produced apparently from the advancing end of the rhizoma, and stand together in a crown, or circle, just as in the common A. spinulosum and its allies. A comparison of Mr. Emerton's drawings in Plates VII. and X. will show both the great resemblance of the two ferns, and their essential distinction. The lobes of the pinnæ in A. Nevadense are a little more apt to be crenated, or even slightly toothed, than those of the other species. The pubescence on the under side of the veins is scantier in this species, and the lobes are not at all ciliated. Another constant character seems to be, that the under surface of the frond is copiously dotted with minute shining resinous globules. The lower part of the stalk bears a few chaffy scales, and similar scales are found on the root-stock.

Mrs. Austin, to whom I am indebted for a full series of fine specimens of the ferns of Plumas County, Caiifornia, has noticed in this fern a sort of sleeping and waking. She says, "The new Aspidium Nevadense has one peculiarity about the fruiting fronds

which I have noticed in no other fern; that is, the divisions of the pinnæ are closed or folded together early in the day. I noticed this last fall. When I went early (while it was yet cool) in the morning for specimens for the press, I would not gather them, as I did not think they would make nice specimens, but went farther up the creek, collecting other plants, and did not return till two or three o'clock, when I found the pinnæ all open, and the fronds fit to press." Some later observations confirmed her in the opinion that this fern at least has its daily periods of contraction and expansion; but whether the change is caused by alternations of light and darkness, dampness and dryness, or heat and cold, is yet undetermined.

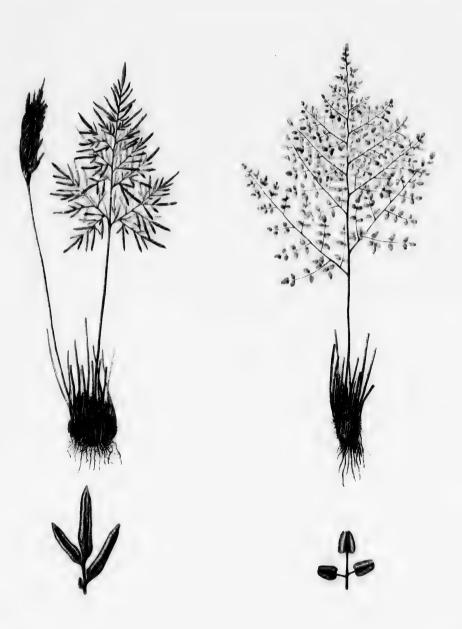
This fern is more or less closely related to that group of Tropical-American species which clusters about Aspidium conterminum; but that species has an erect, not a creeping, rhizoma, and a heavier and more rigid frond. But our plant clearly belongs to the same section of the genus, and would, accordingly, be a Nephrodium, § Lastrea, of Baker, though, as well as can be seen from the withered indusium, scarcely an Oöchlamys of Fée.

The same name, Aspidium Nevadense, was given by Boissier to a Spanish fern; but, as that has proved to be only an already well-known species, there is no impropriety in conferring the name on a fern from the Sierra Nevada of our own country.

Plate X.— Aspidium Nevadense. An entire plant, reduced to about one-third or one-fourth of the natural size, and colored, occupies the middle of the plate. Two fronds, and their root-stock, of natural size, are drawn in outline. At the left is a single segment in fruit, magnified about ten diameters; and at the right an indusium, highly magnified.

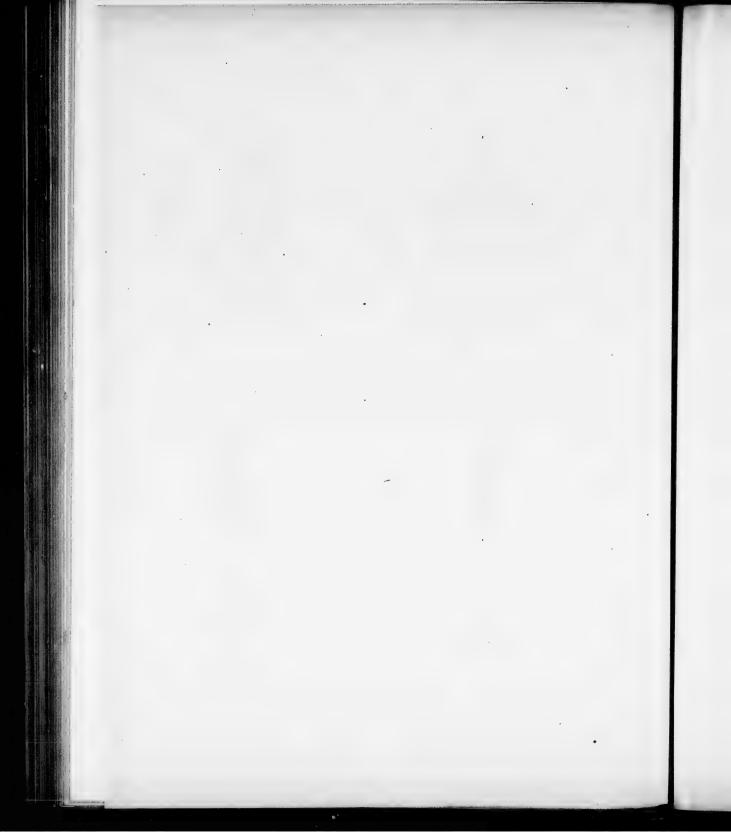






Termoteris. 2011 - Donald A.A., 2000/06

Armstrong withhir-FtQ 2 FEELALA PULCHELLA Per



### PLATE XI. - FIG. 1.

# PELLÆA DENSA, HOOKER.

### Oregon Cliff-Brake.

Pellæa densa: — Root-stocks rather slender, entangled, chaffy with very dark narrow scales; stalks densely tufted, three to nine inches long, wiry and slender, dark chestnut-brown, dull or moderately polished; fronds ovate or triangular-oblong in outline, one and a half to two and a half inches long, closely tripinnate; segments linear, three to six lines long, nearly sessile, sharp-pointed or mucronate, the lower ones distinct, the upper ones often confluent by a narrowly winged rachis; fertile fronds with the segments entire, having the margin narrowly recurved, and provided with a distinct delicate involucre; sterile fronds very rare, the segments broader and sharply serrated, especially towards their apices.

Pellæa densa, Hooker, Sp. Fil., ii., p. 150, t. 125, B. — Hooker & Baker, Syn. Fil., p. 149.

Onychium densum, Brackenridge, Filices of the U. S. Expl. Exped., p. 120, t. 13, f. 2. — Torrey, Pacif. R. Rep., iv., p. 160.

HAB.—Clefts of rocks. Oregon, on the banks of Rogue River, BRACKENRIDGE; near Fort Orford, Gen. A. V. KAUTZ, U.S.A. Not rare in the Sierra of California, at elevations of six thousand to eight thousand feet, from the Castle Mountains to the Yosemite, BREWER, BOLANDER, Mrs. AUSTIN, &c. Also collected at Jackson's Lake, in Wyoming Territory, by Hayden's Expedition.

DESCRIPTION. - The habit of this fern is very dense, as the specific name happily assigned to it by Brackenridge implies. It grows in dense tufts among rocks; and the pinnæ and segments are so crowded as to overlap each other, and render it difficult to see exactly what is the method of branching. The stalks are usually less than a span long, rigid, dark-brown, and rather brittle. The fronds are often only an inch long, and rarely as long as two and a half inches. The primary pinnæ are either alternate or opposite, - more frequently the former. The lowest ones are considerably largest, and in the larger specimens are fairly bipinnate. The secondary atchises, and, indeed, the upper part of the primary rachis, are green and herbaceous; as are also the segments, which are narrowly oblong-linear, acute or mucronate at the apex, having the edges recurved, and bearing a very delicate erosely-toothed proper involucre. The segments, for this reason, are somewhat pod-like. The veins are mostly simple, though occasionally one is forked. They seem to be entirely free; although from Fig. 1, a, of the illustration given by Brackenridge, one would suppose they were reticulated.

Brackenridge's specimens were very old, and somewhat shriveled; and the anastomosing lines which his artist represented are merely the depressions of a contracted surface. Sir W. J. Hooker has noticed on the upper surface of the pinnules, when highly magnified, "an appearance of white, close-pressed, parallel hairs lying in the direction of the margins, tapering at each end, like the hairs of some malpighiaceous plant. A high magnifying power shows that these are not separable from the cuticle, but are rather lodged in it. Can they be looked upon as raphides?"

The cellules of the upper surface are oblong-linear, with sinuous outlines, much as shown in the figure in "Species Filicum;" but I have failed to discover any thing in the least degree resembling raphides.

The sterile fronds are very rarely found; but, when they do occur, their segments have serrated margins,—an uncommon thing in this genus.

Plate XI., Fig. 1. — *Pellæa densa*. A plant of the natural size, showing one frond contracted from drought, as is often the case, and one carefully spread out, so as to display its true form. The smaller drawing shows three fruiting segments enlarged.



#### PLATE XI. - FIG. 2.

## PELLÆA PULCHELLA. FÉE.

# Pretty Cliff-Brake.

Pellæa pulchella:— Root-stock very short, rather stout, nearly erect; stalks numerous, clustered, three to eight inches long, chaffy at the base with narrow crisped scales, nearly black, and polished, like the rachis and branchlets; frond as long as the stalk or longer, deltoid-ovate, quadripinnate at the base, becoming gradually simpler above; ultimate pinnules numerous, very small, one to three lines long, distinctly stalked, oval or cordate-ovate, obtuse, sub-coriaceous, smooth, the edges often much rolled in; involucre herbaceous.

Pellæa pulchella, Fée, Gen. Fil., p. 129; Fougères Mexicaines, Catal., p. 8.

— Ноокег, Sp. Fil., ii., p. 150.— Елтон, in Botany of Mexican Boundary, p. 233.— Ноокег & Вакег, Svn. Fil., p. 150.— Fournier, Mex. Pl. Enum., p. 119.

Allosorus pulchellus, Martens & Galeotti, Syn. Fil. Mex., p. 47, t. 10, f. 1. Allosorus formosus, Liebmann, Mexicos Bregner, p. 68.

Cincinalis pulchella, J. Smith, Ferns, British and Foreign, p. 178.

Pellæa microphylla, METTENIUS, KUHN, in Linnæa, xxxvi., p. 86.

Pellæa pulchella, var. microphylla, BAKER, Syn. Fil., ed. ii., p. 477.

Hab.— Western Texas and New Mexico, Wright, Bigelow, Schott; Mexico to Peru.

DESCRIPTION. - This fern probably grows in the clefts of

exposed rocks; but none of the collectors seems to have made a note of the kind of place where he found it. The fronds are thickly clustered on a short and nearly erect root-stock, which is hidden by the broken remains of old stalks. The stalks are wiry, brittle, shining, and of so dark a brown as to appear almost black. The fronds are broadly triangular-ovate in outline, and in the Texan and New-Mexican plant are about four inches long, and at the base nearly as broad; so that, while they are fully thrice and even four times pinnate at the base, they rapidly become simpler above, and are only bipinnate near the top, and simply pinnate at the very apex. The primary pinnæ and the larger secondary pinnæ are mostly alternate; and the rachises, which are dark and polished like the stalk, are slightly bent from side to side in a zigzag manner, though much less markedly so than in Notholana Fendleri, figured in the last part of this work. The pinnæ all have rather long stalks, and even the ultimate pinnules are distinctly stalked. These pinnules are mostly roundish-ovate, cordate, and very obtuse. Their length is not more than two lines in our plant; though in specimens from Chiapas collected by Dr. Ghiesbreght (No. 227), and in Bourgeau's specimens from Escamela, Mexico, some of them measure two and a half lines. They are sub-coriaceous in texture, smooth, and almost always strongly revolute, or else with the sides folded together so as to hide the fruit; and the texture of the pinnule is somewhat thinner along the margin, so that there may be said to be an herbaceous involucre. The sporangia form a narrow band not remote from the margin of the pinnules.

Among the ferns named by Mettenius, and published after his decease by Kuhn, is *Pellæa microphylla*; which name was bestowed from the Northern specimens of the species above described to distinguish them from the Mexican form, the distinction being, according to Kuhn, that the Northern plant has "furrowed rachises, and the ultimate pinnules smaller, and cordate." The difference in size and form of the pinnules is too slight to be noticed: but our specimens certainly have the rachises slightly sulcate, or furrowed; and no furrowing is visible on the Chiapas specimens, which are, moreover, considerably taller and heavier than our form. But I am as yet unwilling to admit that the difference in size, &c., and in the terete or the furrowed rachises, amounts to a valid specific distinction.

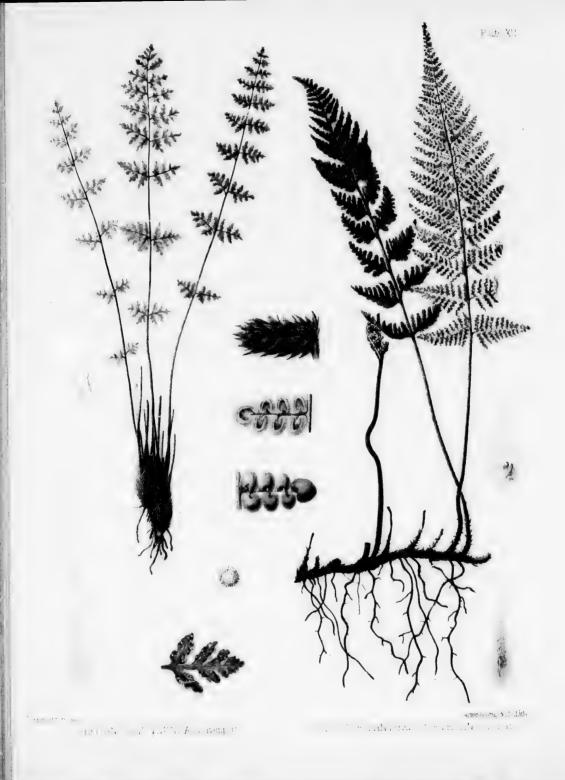
Fournier, in the admirable report on the Cryptogamia of Mexico, has expressed the strange opinion, that *Pellea androme-dæfolia* (Fée) should be united with *P. pulchella*; and some of the specimens which he refers to the latter species surely belong to the other one.

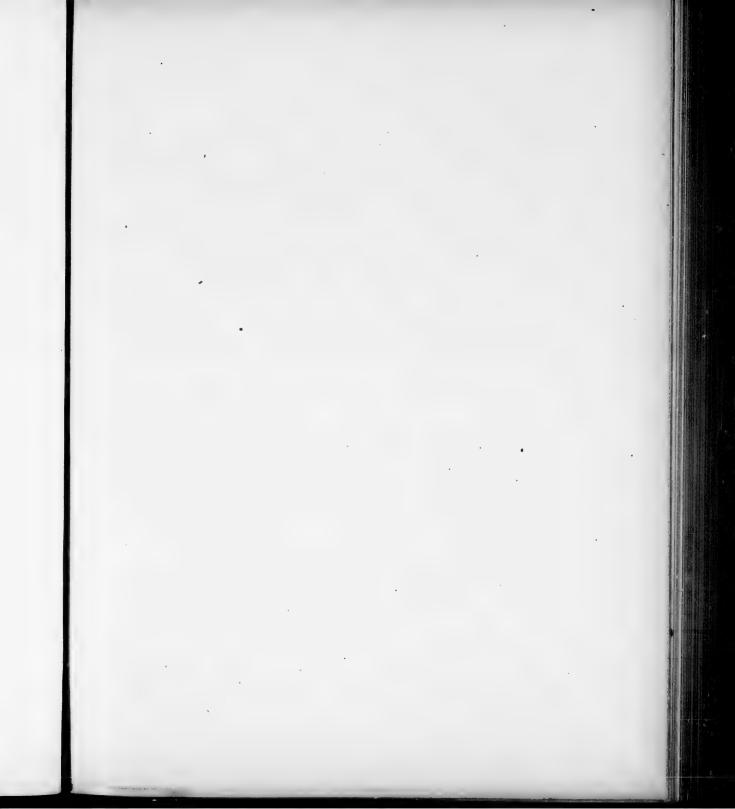
As the synonymy shows, Mr. John Smith, the veteran excurator of the Kew Gardens, has considered this fern a *Cincinalis*, wrongly supposing the pinnules to be farinose.

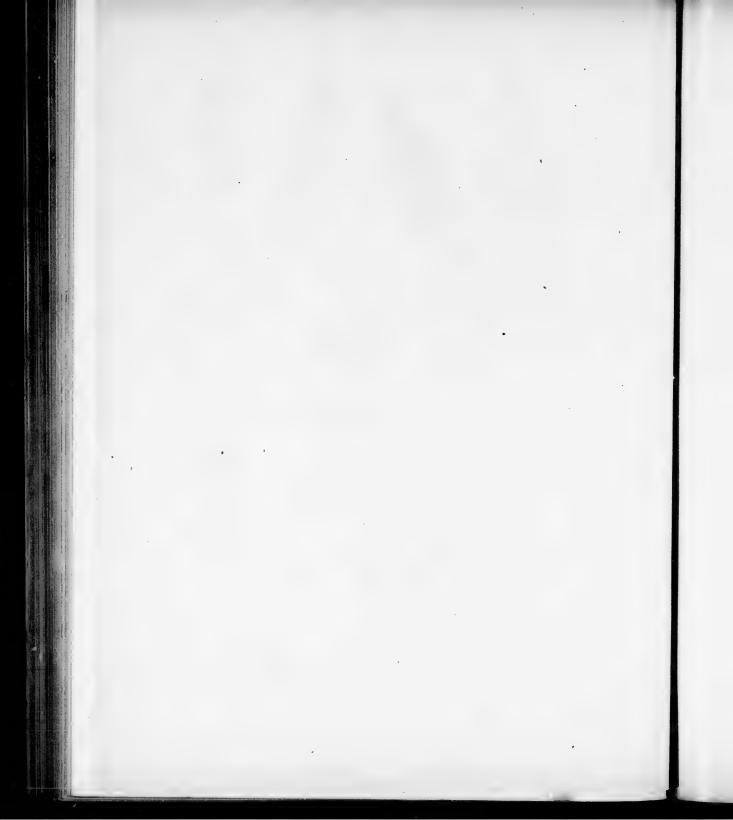
Plate XI., Fig. 2.—A single frond of *Pellæa pulchella*, showing the upper surface with the root-stock and the remains of old stalks. Below it are seen three segments or pinnules slightly magnified.











### PLATE XII. - FIG. 1.

## CHEILANTHES VISCIDA, DAVENPORT.

# Sticky Lip-Fern.

Cheilanthes viscida: — Stalks tufted, three to five inches high, wiry, dark-brown or blackish and shining, chaffy at the base with narrow crisped bright-ferruginous scales; fronds herbaceous, minutely glandular and everywhere viscid, three to five inches long, narrowly oblong in outline, pinnate, with four to six rather distant pairs of nearly sessile deltoid bipinnatifid pinnæ five to six lines wide and long; segments toothed; the minute herbaceous teeth recurved, and each covering one to three sporangia.

Cheilanthes viscida, George E. Davenport, in Bulletin of the Torrey Botanical Club, vi., p. 191 (December, 1877).—Eaton, Ferns of the South-West, ined.

HAB. — At the White-water Cañon in the Colorado Desert, Arizona, and at Downieville Buttes, California, LEMMON; and on the eastern slope of the Sierra, near San Gorgorio Pass, California, PARRY, LEMMON.

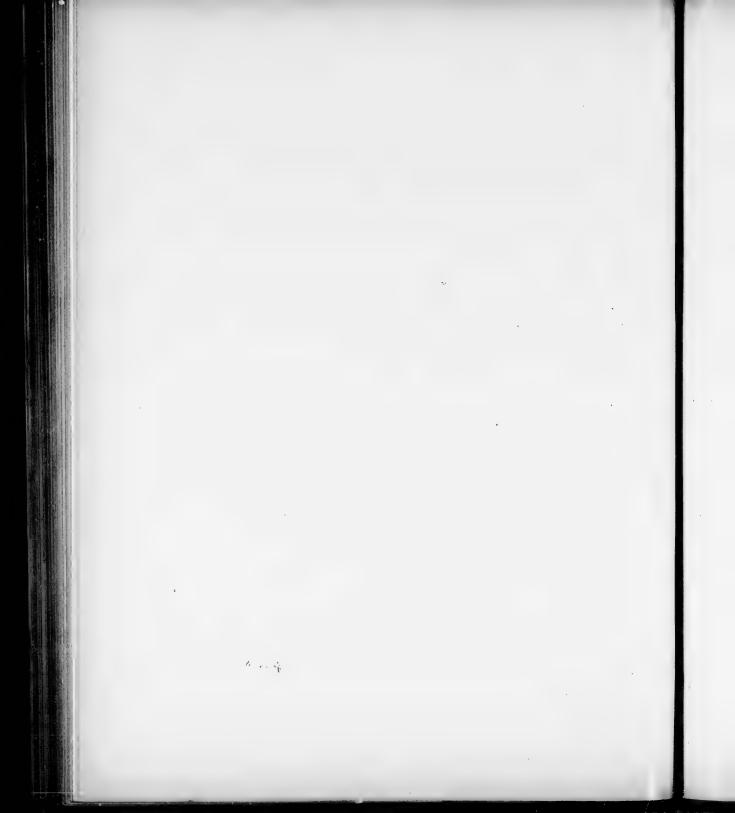
Description.—The root-stock I have not seen; but, as the fronds seem to be tufted, it is probably very short, and heavily covered with the same narrow crisped light-brown scales which adhere to the base of the stalk. The stalks are very slender and fragile, terete, very minutely striated, very dark-brown, and moderately polished. The rachis and the upper part of the stalks are slightly roughened, and bear minute sessile or short-stalked viscid

glands, which also abound on both surfaces of the pinnæ, rendering them very viscid. There are about six pairs of pinnæ; and these, especially the lower pairs, are distant from each other. The pinnæ are broadly triangular in outline, and rather less than half an inch long and broad. They have a short dark-brown viscid-puberulent secondary rachis, which soon passes into an undefined herbaceous midrib. The basal primary divisions of the pinnæ are therefore distinct, and the superior ones confluent. These divisions are ovate-oblong, and are cut into a few pinnately arranged ovate slightly-toothed lobes, the minute teeth recurved to form an involucre. The sporangia are few in number, — probably not more than three to a sorus. The spores are obscurely tetrahedric or almost spherical, and covered with finely reticulated ridges or narrow wings.

In the shape and cutting of the pinnæ, this fern is most like C. Wrightii; but the fronds are rather taller, and are everywhere excessively viscid, in places appearing as if varnished over with the resinous (?) exudation from the glands. The involucre, too, is more herbaceous in C. viscida. The stalk, which is furrowed in C. Wrightii, is perfectly round and without furrow in the present plant; a character which would throw it into Keyserling's § Notholæna of the genus Cheilanthes, but its general affinities are plainly with such species of Cheilanthes as C. Wrightii and C. tenuifolia.

The only specimens I have seen are from the collection of Mr. Davenport.

Plate XII., Fig. 1.—A plant of *Cheilanthes viscida*, with three fronds, that to the right showing the under surface. The magnified drawings represent a scale from the base of the stalk, a fruiting pinna, one of the peculiar glands and a spore, the two last magnified many diameters.



### PLATE XII. - Fig. 2.

# CHEILANTHES CLEVELANDII, EATON.

## Cleveland's Lip-Fern.

Cheilanthes Clevelandii:— Root-stock creeping, elongated, covered with narrow rigid dark-brown scales; stalks scattered, two to six inches long, rather rigid, dark-brown, scaly, but at length nearly smooth; mature fronds four to six inches long, ovate-lanceolate, tripinnate or quadripinnate, smooth and green above, beneath deep-fulvous-brown from the dense covering of closely imbricated ovate-acuminate elegantly ciliated scales, which grow from the rachises and the midribs, and from the under side of the ultimate segments; segments otherwise naked, flattish, nearly round, sessile, one-third to one-half of a line broad, the terminal ones a little larger, the margin narrowly recurved, and unchanged in texture or color.

Cheilanthes Clevelandii, EATON, in Bulletin of the Torrey Botanical Club, vi., p. 33; Ferns of the South-West, ined.

HAB. — Discovered in 1874 on a mountain about forty miles from San Diego, California, at an elevation of about twenty-five hundred feet, by Mr. Daniel Cleveland. Imperfect specimens of possibly the same thing were collected in the San Bernardino Range, in 1875, by Dr. Parry.

Description. — Root-stock nearly as thick as a goose-quill, several inches long, covered with appressed rigid pointed nearly

black scales. Stalks of various ages, from undeveloped buds to weather-beaten fronds, rise from different points along the rootstock. They are about one line in diameter, rigid, and perfectly terete, thus completely invalidating the distinction proposed by Keyserling (see p. 68). The stalk and rachis, when young, are covered with appressed narrow tawny-white scales; but these wear off from the stalk as the frond matures. The fronds are three or four times pinnate; the primary pinnæ either opposite or alternate, and rather closely placed; the secondary, tertiary, and quaternary pinnæ, and the ultimate segments, usually crowded. The ultimate pinnules, if terminal or solitary along the upper part of the tertiary rachises, are roundish-ovate, half a line long, and marked by a slight depression on the upper surface at the base; but the lower lateral segments are perfectly round, and only onethird of a line long and broad, flattish-convex above, concave and with narrowly recurved margins beneath. The scales, which completely hide the under surface of the frond, are at first nearly pure white, but become tawny as the frond matures, so that, when the frond is fully developed, they are of a rich cinnamon-brown. In shape they are ovate-acuminate, with a cordate base, and are elegantly fringed with curving cilia, especially near the base, and sparingly from the surface also. The scales are only half as large as those of C. Fendleri, and are composed of much more tortuous cells. This fern may prove, in the end, to be only a form of C. myriophylla; but that species is woolly as well as scaly, and the scales are larger and not so closely imbricated as in the fern here described.

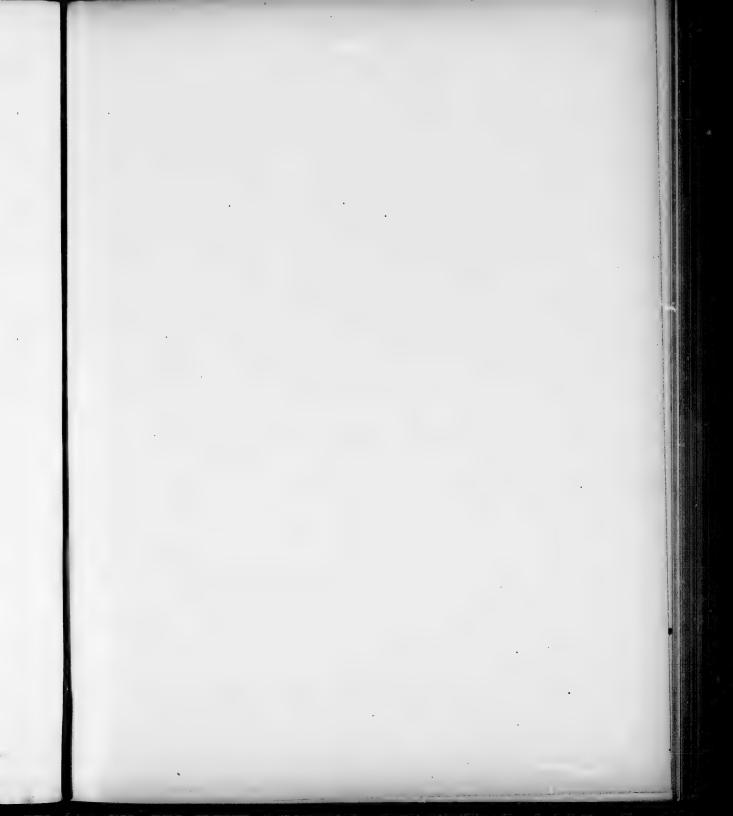
Plate XII., Fig. 2.— Cheilanthes Clevelandii. A plant with two fronds, one showing the upper and one the under surface. In the middle of the plate are three magnified views of a fragment composed of seven of the ultimate segments or pinnules. The upper one represents the under surface, covered with scales; the middle one, the same with the scales removed; and the lower one, the upper surface of the same fragment. To the right are given, at the bottom, a scale from the root-stock; and, above it, a scale from the under surface of the frond.







ASPIDIUM UNITUM, var. GLABRUM, Mett.





#### PLATE XIII.

# ASPIDIUM UNITUM, VAR. GLABRUM, METTENIUS.

### Rounded Shield-Fern.

Aspidium unitum, var. Glabrum:—Root-stock elongated, creeping in advance of the fronds; stalks few, scattered, smooth, one to two feet high; frond nearly or quite as long as the stalk, oblong in outline, rigid, sub-coriaceous, smooth, pinnate, the apex abruptly contracted and pinnatifid; pinnæ numerous, short-stalked, sub-equal, or the lowest ones a little shorter, pinnatifid about half way to the midrib into rounded or obtuse closely-placed lobes; veins pinnate, the lowest ones of contiguous lobes united, and sending out a veinlet to the sinus between the lobes, where the second pair of veins meets it, and sometimes the third also; the upper veins straight and simple; sori forming a continuous intramarginal line around the pinnæ, and often extending down nearly to the midrib; indusium rather persistent, round-reniform, commonly quite smooth.

Aspidium unitum, var. glabrum, Mettenius, in Ann. Mus. Bot. Lugd.-Batavi, i., p. 230. — Елтон, in Bull. Torr. Club, iv., p. 19. — Снарман, in Botan. Gazette, iii., p. 20.

Nephrodium unitum, a, gongylodes, BAKER, Syn. Fil., p. 289.

Aspidium goggylodus, Schkuhr, Krypt. Gew., p. 193, t. 33, c.

Aspidium gongylodes, METTENIUS, über Aspidium, p. 101.

Aspidium Ecklonii, Kunze, in Linnæa, x., p. 546. — Mettenius, l. c., p. 101.

HAB.—Swamps and bogs of Southern Florida, C. E. FAXON, Dr. PALMER, W. R. TOME, INS. Dr. CHAPMAN, &c. Widely distributed throughout the West Indies, Guiana, Brazil, West Africa, the Cape of Good Hope, Mauritius, Ceylon, Java, Sumatra, Borneo, &c.

Description.—The root-stock creeps beneath the surface of the ground, and extends often more than a foot in advance of the fronds: it is angular or furrowed, almost naked, and nearly black in color. It is commonly about one-sixth of an inch in thickness. Scattered along the newer portion are a few short stems, which represent the fronds of the coming year. The stalks are nearly naked, blackish in the lower portion, but becoming green towards the frond: they are erect, and quite rigid. The fronds of the Florida specimens are from one to two feet long; but both larger and smaller specimens occur in foreign collections. The fronds are elongated-oblong in general outline, scarcely or not at all contracted at the base, but abruptly narrowed to a more or less developed slender rinnatifid apex. The pinnæ are from twenty to thirty on each side, from four to six inches long, and from five to eight lines wide. They are usually nearly straight, placed on the rachis at an angle of from fifty to eighty degrees, the lowest ones with a stalk a line long, and the upper ones successively more nearly sessile. Their shape is linear-acuminate, - in the lower half closely pinnatifid into somewhat roundish lobes about half way to the midrib; but the upper half of each one is less deeply lobed, and for the last inch or so only toothed. The sides of the lobes and teeth are often slightly recurved, making the lobes seem more acute than they really are, and giving the apices of the pinnæ a more serrated appearance than properly belongs to them. The frond is sometimes perfectly smooth; but more frequently a few little scales and a very scanty and minute pubescence may be detected along the midribs and veins, and especially along the margin of the lobes. This pubescence is very decidedly developed in var. hirsutum (Mettenius), which has not been found in our territory, but occurs in nearly all other regions where our form has been observed.

The veins are simple, and very prominent on the under surface: usually there are about seven or eight pairs of them to each lobe, but sometimes a larger number. The lowest vein on the inferior side of the mid-vein does not branch out from that midvein, but from the costa of the pinna, just below the insertion, or starting-point, of the mid-vein. The lowest vein on the superior side of the next lower lobe starts sometimes from the costa also; but perhaps as frequently from the mid-vein, very near the costa. These two veins unite at an angle, and send out a single vein to the sinus, or end of the incision between the two lobes. The next pair of veins, and occasionally the third pair also, extend likewise to the sinus; but the superior veins are all free, parallel, and nearly straight.

<sup>&</sup>lt;sup>1</sup> It may be well to give some of the synonymy of this form: — Aspidium unitum, var. hirsutum, Mettenius, in Ann. Mus. Bot. Lugd.-Batav. l. c. Nephrodium unitum, β, propinquum, Baker, Syn. Fil., p. 289.

Aspidium unitum, Schkuhr, Krypt. Gew., p. 34, t. 33, b. — Swartz, Syn. Fil., p. 47. — Willdenow, Sp. Pl., v., p. 241.

Nephrodium propinguum, R. Brown, Prodr., p. 148. — Hooker, Sp. Fil., iv., p. 79 (excluding a part of the synonymy).

The sori are placed one on each veinlet, — on the upper veinlets near the margin of the lobes, but near the middle of the lower veinlets; thus forming a very evident intramarginal line around the lobes of the pinnæ, and descending pretty near the midrib between the lobes.

The indusium is far more rigid and persistent than in most of our other *Aspidia*: it is roundish-reniform, and commonly quite smooth, though Mettenius says "tenuiter pilosum." In the other variety the indusium is densely setose. The spores are bean-shaped, and often have a deeply-impressed hollow on the concave side. Their surface is very minutely roughened.

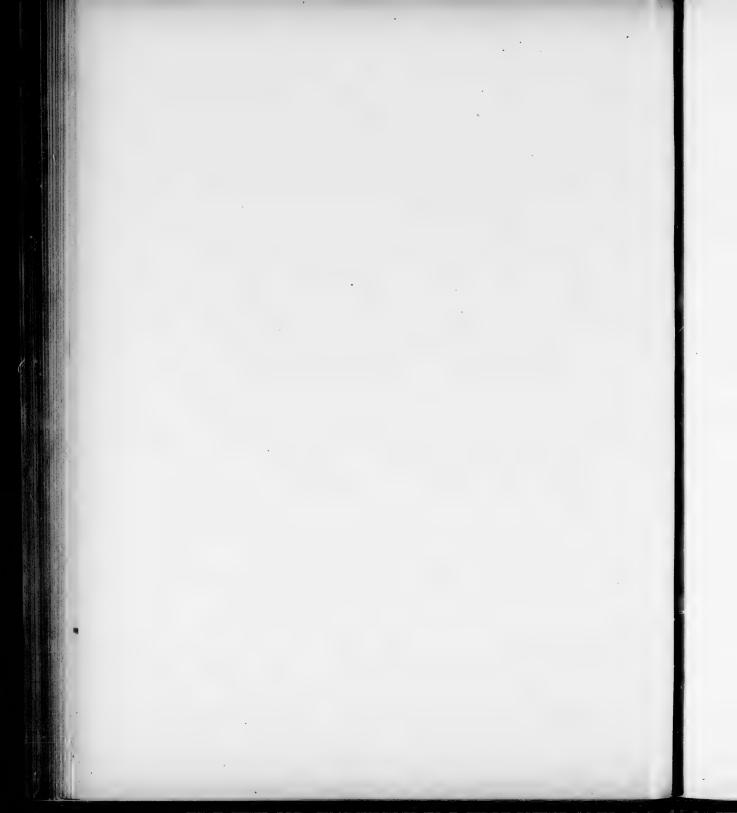
This tropical fern has been known since the beginning of the present century; but it was first discovered within our limits in 1873, when Mr. C. E. Faxon collected it near Enterprise, Florida. In the genus Aspidium it finds a place in the section Nephrodium, as this group was understood by Schott, and defined by Presl (Tentamen, p. 80) and by Moore (Index Fil., p. lxxxvi.). In the Species Filicum and the Synopsis Filicum it is § Eunephrodium of the genus Nephrodium. The group, by whatever name it is called, consists of those Aspidioid ferns which have a reniform indusium, and simple pinnate veins, of which the lower pair or several pairs of contiguous lobes unite at an angle, and send out a ray or veinlet to the sinus. There are in the world about fifty species referable to the group, nearly all of them inhabitants of tropical or sub-tropical climates. Aspidium molle, which may possibly occur along the Gulf shores of our Southern States, belongs near the present species; but, if it should be found,

it can be readily distinguished by its softly pubescent frond and shortened root-stock,

Dr. Mettenius seemed to be confident that his var. glabrum was the Polypodium unitum of Linnæus; but Mr. Baker remarks that the Linnæan specimen so named is the Aspidium cucullatum of Blume and Mettenius. Should this view be finally adopted, it would seem proper to call the present fern by the name assigned to it by Schkuhr, slightly modifying the orthography, so as to correctly represent in Latin letters the Greek word poppional which means roundish, and was evidently intended by Schkuhr to refer to the roundish lobes of the pinnæ.

The synonymy of both forms of this species is very much involved, and perhaps will never be entirely cleared up. Ampler synonymy may be found in Hooker's Species Filicum, and in Dr. Mettenius's account of Indian and Japanese ferns, in the Annals of the Leyden Botanical Museum.

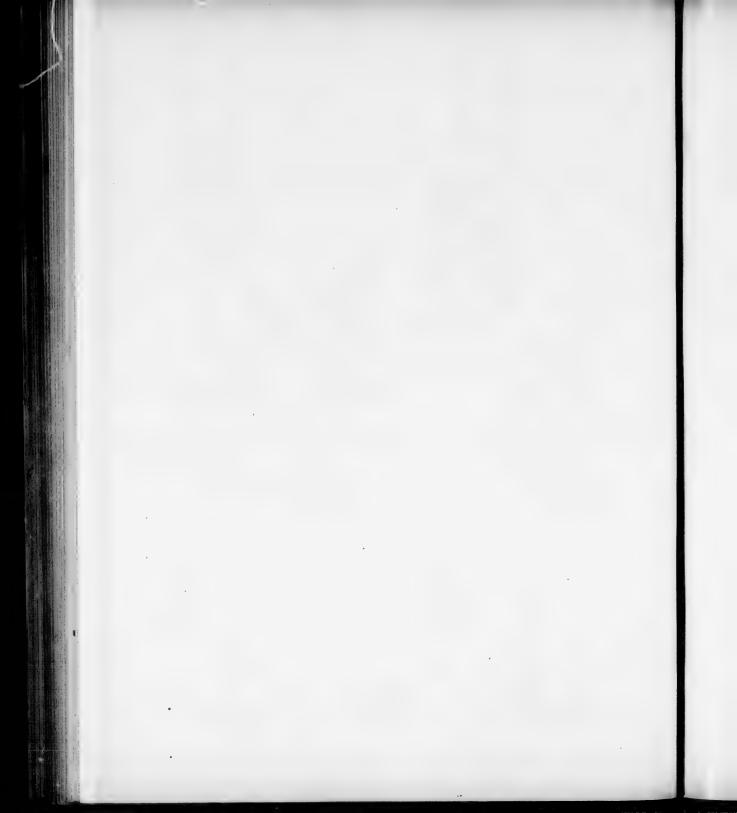
Plate XIII.—A frond of Aspidium unitum, var. glabrum, with the nearly naked elongated root-stock. A pinna, slightly enlarged, shows the position of the fruit-dots; and in two lobes, enlarged about six diameters, the peculiar venation is well exhibited. The indusium, with its sinuous-margined cellules, is highly magnified.











## PLATE XIV. - Fig. 1.

# ANEIMIA MEXICANA, KLOTZSCH.

#### Mexican Aneimia.

ANEIMIA MEXICANA: — Root-stock short, creeping, covered with narrow curling blackish scales; stalks four to eight inches long, pale, smoothish, wiry, furrowed on one side; fronds coriaceous, glabrous, shining, paler beneath; sterile ones deltoid-ovate, four to six or even nine inches long, having about four to six short-stalked sub-cordate ovate-acuminate minutely but very sharply serrulate pinnæ on each side, and a terminal one nearly as large as the rest; veins free, forking from a distinct mid-vein, closely placed, and giving the surface a striated appearance; fertile frond like the sterile, except that the two lowest pinnæ are changed into long-stalked erect narrow pinnately-compound panicles of fructification; the ultimate divisions narrow but flat, and bearing on the under surface a double row of sessile acorn-shaped sporangia, which have a reticulated surface and a radiated cap at the top.

- Aneimia Mexicana, Klotzscu, in Linnæa, xviii., p. 526. Kunze, in Linnæa, xxiii., p. 223; Die Farrnkräuter, ii., p. 75, t. 131. Ноокек, Ic. Plant., t. 988. Ноокек & Вакек, Syn. Fil., p. 443. Еатон, in Botany of the Mexican Boundary, p. 235.
- Aneimia speciosa, Prest, Suppl. Tent. Pterid., p. 89. Liebmann, Mexicos Bregner, p. 151. (A smaller mountain-form, figured as var. paucifolia by Hooker, Second Cent. of Ferns, t. 65.)

HAB. — On shady river-cliffs near New Braunfels, Texas, LINDHEIMER. Medina, in Western Texas, and in a rocky arroyo at the mouth of the River Pecos, Wright. Not collected in recent years. It was first described from Aschenborn's Mexican specimens, and is now reported as found also in Guatemala.

DESCRIPTION. — The root-stock is creeping, though probably not greatly elongated; it is covered with narrow fuscous or blackish scales, which are curled rather than crisped, and is developed slightly in advance of the growing fronds. These are nearly erect, and their whole height is from six to about fifteen inches. Fully half this height consists of the stalk, which is slender and straw-colored, - at least in dried specimens. The sterile portion of the fertile frond, and the sterile frond, are exactly alike: the general shape is triangular-ovate. The pinnæ are sub-coriaceous, and commonly about five or six on each side besides the terminal one, — the lowest ones with a distinctly cordate base, the upper ones with a rounded or truncate base, usually having the upper side a little fuller and rounder than the lower. All the pinnæ are short-stalked,—the lowest ones with a stalk two lines long, the upper ones having them gradually shorter. The general shape of the pinnæ is between ovate and lanceolate. The pinnæ have a well-marked mid-vein, distinct to the very apex, and very closelyplaced forking veins on each side of it. These veins give the surface a striated appearance. The tips of the veins extend to the apices of the minute but very sharp and incurved serratures along the margin of the pinnæ. In the fertile frond there are two narrow pinnately-compound panicles, which are raised on

stalks almost as long as the sterile portion, and appear to be its two lowest pinnæ developed into fructification. Kunze notes that the fruiting branchlets are herbaceous-margined, glandular-pubescent, and more or less dilated and confluent at the apex of the panicle. The sporangia have a horizontal apical ring, much as in Lygodium; but are attached by the bottom, not by the side as in Lygodium. They are arranged in a double row on the divisions of the fruiting panicle. The spores are very beautiful: they are roundish-tetrahedral, the sides covered with curious elevated and sometimes forked ridges, which Kunze considers characteristic of the genus.

The genus Aneimia has but two species within our limits, but is represented in the tropics — principally in Tropical America — by about twenty-seven species. The generic character is this: Sporangia acorn-shaped, with a transverse apical ring, like a radiated cap, sessile in two rows on the branchlets of a panicle. Panicles either separate fronds, or in pairs, — in the latter case being the changed and long-stalked lower pinnæ of an otherwise sterile and pinnately-divided frond. As already pointed out on page 4, the genus is associated with Lygodium, Mohria, Schizæa, and Trochopteris. The name was originally written Anemia by Swartz, who took it "from the Greek word Avinov, not clothed, naked, because the capsules, without any covering, rest naked in the spikelets." But as the Greek word is really Areipar, Kaulfuss wrote the word Aneimia; in which orthography he has been generally, though not universally, followed. The curious reader will find an amusing note in regard to this matter on page 23 of Link's "Ferns of the Berlin Garden."

Plate XIV., Fig. 1.—Aneimia Mexicana. A root-stock bearing a single frond, the stalk cut in two for convenience. One side of a sterile pinna is drawn twice the natural size, to show the venation; and to the left is a single sporangium, greatly magnified, and exhibiting the apical ring.

### PLATE XIV. - Fig. 2.

## ANEIMIA ADIANTIFOLIA, SWARTZ.

#### Maiden-hair Aneimia.

Aneimia adiantifolia: — Root-stock creeping, terete, and covered with fine blackish-fuscous scales; stalks somewhat scattered, erect, a span to a foot high, brownish and sparingly chaffy-tomentose near the base; fronds shorter than the stalk; the sterile portion deltoid-ovate, sub-coriaceous, pubescent along the rachises, more or less glossy on both surfaces, twice or thrice pinnate; pinnæ triangular-lanceolate, acute or obtuse; pinnules obovate or ovate with a cuneate base, often lobed, or the larger ones pinnatifid, toothed at the apex, striated by the free forking veinlets; fertile panicles long-stalked from the base of the sterile segment, pinnately compound, the branchlets flattened, and bearing the sessile acorn-shaped sporangia in double rows.

Aneimia adiantifolia, SWARTZ, Syn. Fil., p. 157. — WILLDENOW, Sp. Pl., v., p. 94. — KUNZE, in Linnæa, ix., p. 21; xviii., p. 309; xxiii., p. 221. — PRESL, Suppl. Tent., p. 85. — HOOKER & GREVILLE, Ic. Fil., t. 16 (var. asplenifolia). — EATON, in Chapman's Flora of the Southern States, p. 598. — GRISEBACH, Flora of Brit. W. Ind. Isl., p. 650. — HOOKER & BAKER, Syn. Fil., p. 434. — Fée, Foug. Mex. Cat., p. 41. — FOURNIER, Mex. Pl., Crypt., p. 139.

Osmunda adiantifolia, LINNÆUS, Sp. Pl., p. 1520.

Ornithopteris adiantifolia, Bernhardi, in Schraders N. Journ. Bot., 1806, ii., p. 50, t. 3; fig. 15 b.

Anemirhiza adiantifolia, J. Smith, in Seemann's Bot. Voy. "Herald," p. 243.

Osmunda Filiculæ folio major, Plumier, Fil. Amer., p. 135, t. 158.

Aneimia asplenifolia, Swartz, Syn. Fil., p. 157.

Ancimia caruifolia, Presl, Reliq. Hænk., i., p. 74; Suppl. Tent., p. 85, &c.

HAB. — Southern Florida, Biscayne Bay, Key West, &c. It is found in one form or another in the West Indies, Mexico, Central and South America, growing in pine woods, WRIGHT; and on old ruins, A. SCHOTT.

Description.—This fern has a terete creeping root-stock, about the eighth of an inch in diameter, and several inches long, covered with minute nearly black subulate chaff, composed of a single series of cylindrical cells. The stalks arise in a single series from the upper side of the root-stock. The lower portion of the stalk is dark-colored, and moderately pubescent with slender brown articulated hairs; but the upper part is much lighter, and almost smooth. In large specimens from the West Indies the stalk is a foot long; but in the Florida specimens it is several inches shorter. The sterile fronds are placed on shorter stalks than the fertile ones, as is very commonly the case in most genera of ferns. The sterile fronds, and the sterile portion of the fertile fronds, are triangular-ovate in shape, from four to eight or nine inches long, and at the base about three-fourths as broad. They are sub-coriaceous in texture, rather rigid, and more or less hairy along the rachises and on the under side of the veins. The upper surface has a striated appearance, and is glossy, but still bears a few minute scattered hairs.

The sterile frond, or segment, is bipinnate in ordinary speci-

mens, and tripinnate in very large ones. The pinnæ are pinnately lobed or divided, and often have an acuminate apex, especially in very large plants. The segments are lobed or not, according to the size of the frond; but the ultimate segments and lobes are rhomboid-ovate or obovate, — broadly or narrowly so in different specimens, — the apex obtuse or barely acute, and always with a few minute teeth. The veins are free and flabellately forking, so that the lobes have no distinct mid-vein.

As in the Mexican Aneimia, so in this one, the fertile panicles are long-stalked, and rise from the top of the stalk, just at the base of the sterile portion of the frond. They are usually twice pinnate, and have short pinnately-divided pinnules, the segments of which are flattened, and bear two rows of acorn-shaped sporangia provided with a terminal transverse apical ring,—the characteristic of the sub-order to which the plant belongs. The spores are roundish-tetrahedral, and have minute ridges on the surface, but not so well developed as those of the species last described.

The Florida specimens are not very large, and belong to the form figured by Hooker and Greville under the name of var. *asplenifolia*, having the sterile frond barely bipinnate, and the divisions obtuse.

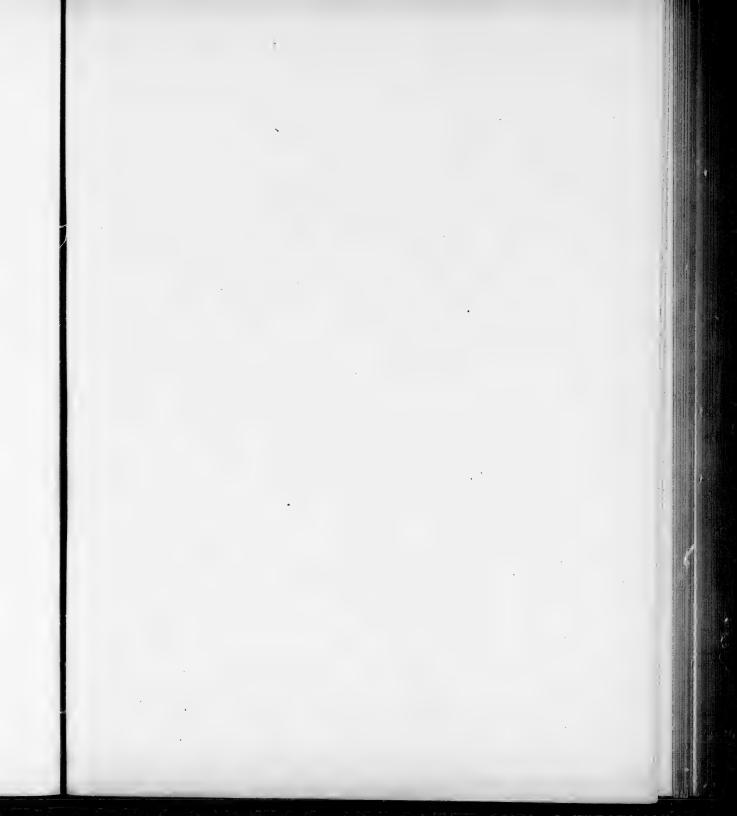
Authors have attempted to separate from the genus Aneimia those few species which have anastomosing veins, and to make of them the genus Anemidictyon, and in like manner to place the species which have the fertile fronds destitute of a foliaceous sterile portion under the separate genus Coptophyllum; but it

seems more natural to keep all the species together, and to use the characters of venation and of the combination or separation fertile and sterile fronds only for making sections. Mr. John Smith's proposition (in the Botany of the Voyage of H. M. S. "Herald"), to establish the genus *Anemirhiza* for the present fern, because "the fronds are distant, and produced in a single series from an elongating creeping axis, which assumes the form of a rhizome," he seems to have abandoned in his later writings.

Plate XIV., Fig. 2.—An entire plant of *Ancimia adiantifolia* of the natural size. The details are a portion of the fructification enlarged, and a highly-magnified sporangium.









#### PLATE XV. - FIG. 1.

## ASPLENIUM RUTA-MURARIA, LINNÆUS.

#### Wall-Rue.

ASPLENIUM RUTA-MURARIA: — Plants of small size; root-stocks short, creeping, entangled; stalks tufted, one to three inches long, green, brownish at the base; fronds evergreen, sub-coriaceous, smooth, nearly as long as the stalks, deltoid-ovate in out-line, laxly bi-tripinnate at the base, pinnate towards the apex, the divisions alternate; ultimate segments few, stalked, two to five lines long, varying from narrowly cuneate to broadly rhomboid or even roundish-obovate, the apices or outer margins crenate, toothed, or deeply incised; mid-vein none, veinlets free, flabel-lately forking; sori linear-oblong, two to four to a segment, confluent when ripe; indusium very delicate, having a ciliated margin.

Asplenium Ruta-muraria, Linnæus, Sp. Pl., p. 1541. — Swartz, Syn. Fil., p. 85. — Willdenow, Sp. Pl., v., p. 341. — Schkuhr, Krypt. Gew., p. 75, t. 80, b. — Mettenius, über Asplenium, p. 143. — Hooker, Sp. Fil., iv., p. 176. — Moore, Nat. Pr. Brit. Ferns, t. 41, A. — Heufler, Aspl. Sp. Eur., p. 329. — Milde, Fil. Eur. et Atl., p. 76. — Michaux, Fl. Bor. Am., ii., p. 266. — Pursh, Fl. Am. Sept., p. 667. — Bigelow, Fl. Boston., ed. iii., p. 422. — Darlington, Fl. Cest., ed. iii., p. 393. — Torrey, Fl. New York, ii., p. 492. — Gray, Manual, ed. omn. — Eaton, in Chapm. Fl., p. 593.

Asplenium murorum, Lamarck, Flore Française, i., p. 28.

Asplenium murale, Bernhardi, in Schraders Journal für die Botanik, 1801, i., p. 19.

Scolopendrium Ruta-muraria, Roth, Fl. Germ., iii., p. 52. Tarachia Ruta-muraria, PRESL, Epimel. Bot., p. 81.

HAB. — Clefts of calcareous rocks, from Vermont to North Carolina, and westward to Indiana and Tennessee, but not seen on walls in America. It is common throughout Europe on walls and on rocks, especially calcareous rocks. It has been noticed in Algeria, and in Asia as far east as Cashmere.

Description. — Root-stocks short, creeping, entangled; covered, like the base of the young stalks, with narrow slender-pointed blackish scales. These scales are composed of irregular oblong cells, with the dissepiments very heavy and black. The slender tips are composed of two series of cells; and it is only the wall between the adjacent cells that is thickened, the walls along the edges of the scale being thin and transparent. The analogy to the structure of a tooth of a moss-peristome is noticeable.

The stalks are of variable length, according to the size of the plant and its place of growth. In bare, sunny spots, the whole plant will be scarcely an inch high; while, on damp and shaded rocks, specimens fully six inches long have been collected. The stalks are green and herbaceous except at the very base, where they are deep-brown and more rigid, and, as Dr. Milde has especially noticed, furnished with globose unicellular glandules of a grayish color, "so large that you might take them for unicellular

algæ." The fibro-vascular bundle seems in the living plant to be flattened-cylindrical in shape, and at the very base of the stalk to have a blackish mass of sclerenchyma in front of it. Near the base the surrounding tissue is semi-transparent, with an exterior layer of dark cells; but higher up the surrounding tissue is filled with chlorophyll, and the outside layer is colorless. A more careful study of the stalk would probably discover other peculiarities which have escaped my observation.

The frond is generally a little shorter than the stalk, and is triangular-ovate or deltoid in outline. It is simply pinnate near the apex, but twice pinnate, or even three times pinnate, near the base. It is, when mature, perfectly smooth, and of a sub-coriaceous texture. The rachis and its divisions are quite slender, and green like the segments. These are extremely variable in form, so that from their shape no less than nine varieties have been distinguished by Heufler. In small plants, grown in dry exposed places, the segments are roundish-obovate, with a cuneate base, and the outer edge merely crenate. More frequently the form is cuneate-rhomboid with the outer edges toothed; and specimens, either large or small, with narrower and deeply-incised segments, are by no means rare. These forms all occur indiscriminately; and it seems better to simply record the great variability of the form of the segments than to split up the species into nine varieties, with Heufler, or ten, with Milde.

The sori are long or short, and variable in number, according to the size and shape of the segment. When fully ripe, the sporangia nearly cover the under surface, so that the fern has been

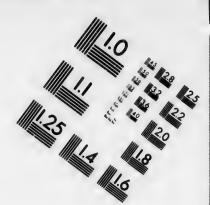
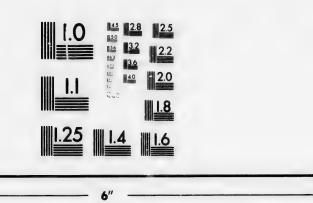


IMAGE EVALUATION TEST TARGET (MT-3)



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mistaken for an *Acrostichum*. The indusia are mostly single; but now and then a double, or diplazioid, indusium will be found. They are very delicate, and have, as Schkuhr has well shown in his figure, a beautifully ciliate margin. Spores ovoid-bean-shaped, with a minutely-roughened surface.

This species need not be confounded with any other in North America. Asplenium montanum and A. septentrionale are the nearest, and from both of these it is very easily distinguished. There is in Europe a more closely related species, — A. Germanicum, — which may be known by the fewer, narrower, and decidedly incurved segments, and especially by having the indusium entire, and not ciliated. The wall-rue has been known to botanists for three hundred and fifty years; and in Heufler's work on European Asplenia there may be found many references to ante-Linnæan descriptions of it, as well as a more abundant citation of later references than I have thought necessary to give. See also Moore's Index Filicum and Milde's European and Atlantic Ferns.

Mr. Emerton's illustration represents one of the commonest American forms of this variable little fern.

### PLATE XV. - Fig. 2.

### ASPLENIUM SEPTENTRIONALE, HOFFMANN.

### Forked Spleenwort.

Asplenium septentrionale: — Root-stocks short, creeping, densely tufted, covered with narrow blackish chaff; stalks very slender, three to six inches high, dark-brown at the base, green above, alternately forked, the branches gradually widening into two to five very narrow cuneate and acuminate segments, which are six to fifteen lines long, scarcely a line wide, and incisely toothed at the apex; texture sub-coriaceous, and rather rigid; veins forked, closely parallel; sori clongated, one to three on a segment; indusia delicate, entire, or very sparingly ciliate.

Asplenium septentrionale, Hoffmann, Deutschlands Flora, ii., p. 12.—
Swartz, in Schraders Journal, ii. (1800), p. 50; Syn. Fil., p. 75.
— Schkuhr, Krypt. Gew., p. 62, t. 65.— Willdenow, Sp. Pl., v., p. 307.— Presl, Tent. Pterid., p. 106, t. 3, fig. 8.— Moore, Brit. Ferns, Nat. Print., t. 41, C.— Mettenius, über Asplenium, p. 141.
— Hooker, Sp. Fil., iii., p. 174; Brit. Ferns, t. 26.— Milde, Fil. Eur. et Atl., p. 81.— Eaton, in Bot. Mex. Boundary, p. 235.— Porter & Coulter, Syn. Fl. Colorado, p. 154.

Acrostichum septentrionale, LINNÆUS, Sp. Pl., p. 1524.

Pteris septentrionalis, SMITH, in Mem. Acad. Turin, v., p. 412.

Scolopendrium septentrionale, ROTH, Fl. Germ., iii., p. 49.

Acropteris septentrionalis, LINK, Hort. Berot, ii., p. 56; Fil. Sp. Hort. Berol.,

p. 80. — Fée, Gen. Fil., p. 77, t. b, A. — Heufler, Aspl., Sp. Eur., p. 344.

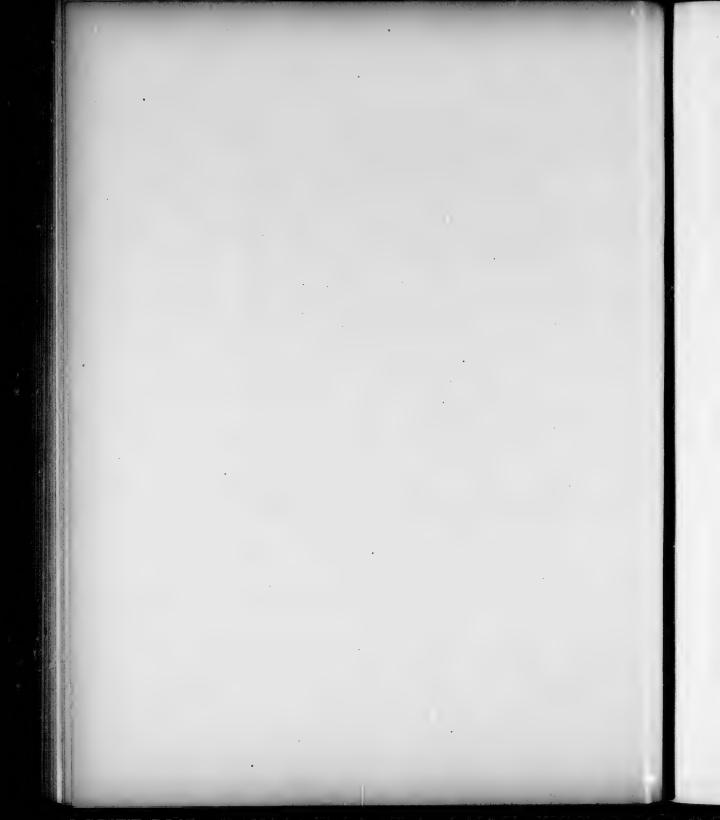
Amesium septentrionale, NEWMAN, Hist. Brit. Ferns, ed. iii., p. 265.

HAB.—On Ben Moore, New Mexico, Bigelow, Wright. Colorado, HALL & HARBOUR; and growing with Asplenium Trichomanes along the brink of the Grand Cañon of the Arkansas, Brandegee. It is found in crevices of rocks and on walls in Great Britain and in the mountainous regions of Europe, and in Asia as far as Cashmere and Kumaon.

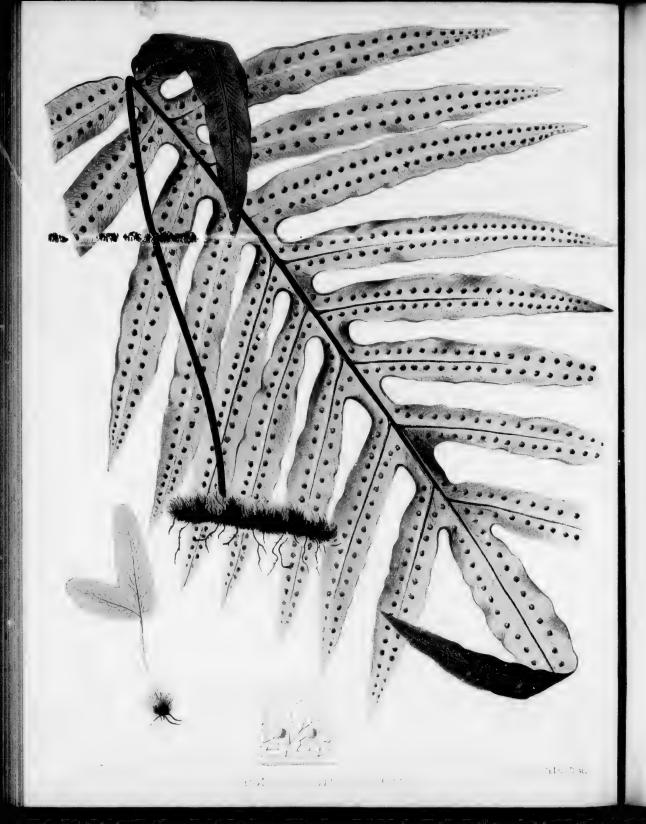
DESCRIPTION. — The habit of growth is very much as in the wall-rue, except that this species forms still more extended tufts. The scales of the root-stock are very similar to those of the species just named, but bear a few pedicelled marginal glands. The stalks are commonly longer than in the other species; and, after the upper greenish portion has broken away, the lower or darkbrown part persists a long time. The section of the upper part of the stalk shows that it has three longitudinal furrows, though two of these may be due to drying. The fibro-vascular bundle is oval in section, and the central or more truly vascular portion of it is triangular with hollowed sides. The stalk is either forked or alternately branched at the top, and bears from two to five very narrow segments. These taper both at the base and apex: they are sometimes forked, but more frequently toothed and incised towards the apex. The veins are forked near the base of the segment into as many closely parallel veinlets as there are teeth to the segment. The sori are often nearly an inch long and, when the sporangia are ripe, nearly cover the back of the segment. The indusia open towards the median line of the segment, and are so broad as to sometimes overlap each other. They are composed of cellules with very sinuous borders, and have a usually entire edge, though here and there a few short marginal hairs may be detected,—a point which seems to have escaped the close and usually accurate observation of Milde. The spores are ovoid-bean-shaped, and minutely roughened. It is a somewhat remarkable thing in the geographical distribution of ferns, that this curious little fern should be by no means uncommon in the mountainous regions of Europe and of Western and Southern Asia, and should occur in America, not in those parts of the continent nearest to Europe, nor in the more northern regions, but in what may be called the very heart of the continent. I believe Dr. J. M. Bigelow was the first to detect it, in 1851; though it may have been collected by Mr. Charles Wright a little earlier.

A glance at the synonymy will show the very great diversity of views which authors have formerly held as to its generic affinities; but the more recent writers on the subject, with scarcely an exception, have considered it an Asplenium. Mr. Newman, who proposed to erect the genus Amesium for this plant and for A. Ruta-muraria and A. Germanicum, was disposed to doubt whether all the three might not be so connected together by intermediate forms as to constitute but one really good species.

Mr. Emerton has taken his illustration from a plant, with five fronds, collected by Mr. Brandegee in Colorado. Cue segment is shown, somewhat magnified.







#### PLATE XVI.

## POLYPODIUM AUREUM, LINNÆUS.

### Golden Polypody.

Polypodium Aureum: — Root-stock stout, creeping, very chaffy, with narrow bright-brown scales; stalks scattered, rather strong, six to eight inches high, brownish, smooth, and somewhat shining; fronds a foot or more long, sub-coriaceous, smooth, glaucous-green, especially beneath, ovate in outline, deeply pinnatifid; lobes three to six inches long, five to eighteen lines wide, oblong-lanceolate from a broad base, undulate on the margin, but otherwise entire, the terminal one as large as the others; veins reticulated, forming narrow areoles along the midrib, outside of these one or two rows of larger ones enclosing soriferous veinlets, and between these and the margin numerous small sterile areoles; sori in a single row each side the midrib of the segments, or in large fronds in two or three rows, the outer row irregular, commonly seated on the connivent tips of two included veinlets.

Polypodium aureum, Linnæus, Sp. Pl., p. 1546. — Swartz, Syn. Fil., p. 32. — Schkuhr, Krypt. Gew., p. 13, t. 12. — Willdenow, Sp. Pl., v., p. 169. — Hooker, Sp. Fil., v., p. 16. — Eaton, in Chapman's Flora, p. 588. — Hooker & Baker, Syn. Fil., p. 347.

Pleopeltis aurea, PRESL, Tent. Pterid., p. 193.

Chrysopteris aurea, Link, Fil. Sp. Hort. Berol., p. 121. — Fée, Gen. Fil., p. 265.

Phlebodium aureum, R. Brown. — J. Smith, "in Hook. Journ. Bot., iv., p. 58." — Hooker, Gen. Fil., t. 112. — Moore, Ind. Fil., p. lxxiii.

HAB. — Epiphytic on trees, especially on the palmetto, in the peninsula of Florida. Common in the West Indies, and in South America as far as Brazil.

Description.—The root-stock is creeping, and properly but little thicker than a goose-quill; but it is so abundantly covered with bright-brown acuminate ciliated chaff, that the apparent diameter is half an inch. As in all the true *Polypodia*, the root-stock bears scattered prominences, or knobs, to which the separate stalks of the fronds are articulated, and from which they fall away when finally withered.<sup>1</sup> The height of the fronds in the Florida plant is from a few inches to two feet, of which about one-third is stalk, and two-thirds frond proper. The stalk is rather rigid, perfectly smooth, when fresh somewhat glaucous, but in herbarium specimens of a brownish color. It passes gradually into a strong midrib.

In very young plants the frond is simple, or three-lobed; but

<sup>&</sup>lt;sup>1</sup> This mode of growth, Mr. John Smith, the former curator of the Royal Botanical Gardens at Kew, now a man of venerable age, has described, and carefully distinguished from the commoner mode which is seen in Aspidium, Asplenium, Phegopteris, &c. The former he calls "Eremobryoid," and the latter "Desmobryoid." In the Eremobrya "each frond springs from a separate node, more or less distant from its neighbor, and is there articulated with the rhizome; so that, when it has passed its maturity, it separates at the node, and leaves behind a clean concave scar. . . . The essential distinction between the Eremobrya and Desmobrya rests in the fronds of the former being articulated with the axis, while those of the latter are adherent and continuous with the axis."

in larger plants it is ovate or oblong-ovate in outline, and consists of a variable number (five to twenty-five) of ample oblong-lanceolate segments, which are separated by more or less rounded and open sinuses, leaving a border a third of an inch wide along each side of the general midrib. The two lowest segments are sometimes distinctly separated from the rest, and are usually slightly decurved. The central wing widens gradually upwards, and at the apex of the frond is continued out into an undivided terminal segment, which is nearly or quite as large as any of the others. The segments are undulate or wavy, but entire, and have a very narrow cartilaginous line-like border. The texture of the frond is firm and sub-cartilaginous; and the color is a glaucousgreen, becoming on the under surface paler and more decidedly glaucous.

The venation is peculiar, and, as the synonymy shows, has puzzled those authors who have endeavored to divide up *Polypodium* into a dozen or more genera, based principally on differences in venation. Each segment has a central midrib, and on each side of it numerous reticulated veins and veinlets. Closely bordering the midribs (both general and partial) is a series of narrow elongated meshes or areoles. Outside of these are one or two irregular rows of broader areoles, with smaller ones variously interposed. These larger areoles generally contain each a large round or slightly oval sorus or fruit-dot, which is placed sometimes at the apex of a single included veinlet, or more frequently at the united extremities of two or even three included veinlets, which, when the sori are in but a single row each side of the mid-

rib, rise from the back, or outer margin, of the narrow basal (or paracostal) areoles. Outside of the fruit-containing areoles are other smaller areoles, usually in the shape of narrow hexagons, and destitute of included veinlets. The group of ferns to which this plant belongs was first clearly distinguished by the learned ROBERT BROWN, under the name of Phlebodium, probably in "Plantæ Javanicæ Rariores," - a work to which, unfortunately, I have not access. But his remarks upon it are quoted in Hooker's "Genera Plantarum." Phlebodium has been accepted as a genus by John Smith and Moore, but was reduced—very properly, as I think—to a section of Polypodium by Hooker. With Mettenius, the name has been applied to a much larger assemblage of Polypodia; but, as used by Hooker and Baker, it includes only three species, -P. nigripes (Hooker) from Venezuela, P. aureum, and P. decumanum. With P. aureum are associated as varieties P. areolatum (H. B. K.) and P. pulvinatum (Link). These vary somewhat from the character of *P. aureum* as given above, but are probably not specifically distinct, although so considered by many authors of high reputation. They occur in Mexico, the West Indies, and South America. The first variety, areolatum, which includes P. sporadocarpum (Willd.), is thus defined by Hooker and Baker: "Frond smaller, more coriaceous, very glaucous, the lobes closer, the sori uniserial, and barren arcoles with no free veinlets." The latter, pulvinatum: "Like areolatum in sori and venation, but the frond hardly at all glaucous, and the terminal lobe very small."

The Golden Polypody takes its name undoubtedly from the

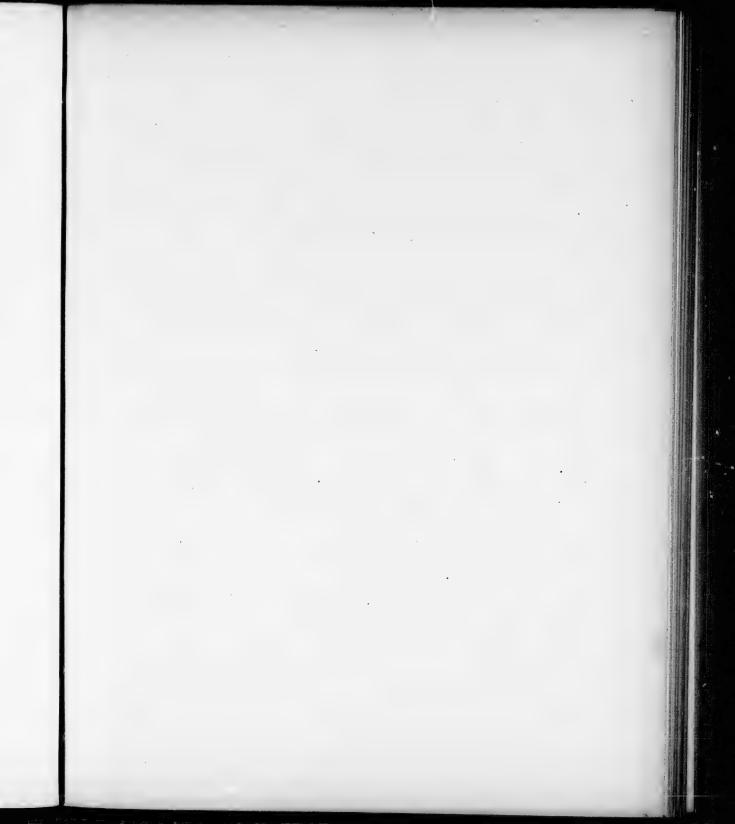
luxuriant golden-brown chaff of the rhizoma. It was discovered long ago in the West Indies, and received from ante-Linnæan botanists a variety of names. Plumier figured it at Plate 76 of his magnificent folio, "Traité des Fougères de l'Amérique" (published in 1705), and named it *Polypodium majus aureum*. He says, "Ce Polipode a la racine grosse environ d'un pouce, et longue bien souvent d'un pied, ronde, noüeuse, rameuse, charnuë, verdastre en dedans, d'un goust astringent, et toute couverte de petites écailles dorées." It forms one of the finest ornaments of the ferneries, in which it is frequently cultivated.

The genus *Polypodium* — even when limited, as by Mettenius, to the ferns having round or roundish naked sori, composed of sporangia with an incomplete vertical ring, the stalks of the fronds articulated to the rhizoma — contains several hundred species. Mettenius gives two hundred and sixty; and, in the second edition of "Species Filicum," Mr. Baker brings up the number to three hundred and forty. The great differences in the size and outlines of the frond, in the venation, in the texture, and in the surface, whether smooth, hairy, tomentose, or scaly,—and in the presence or absence of peltate scales among the sporangia, have induced writers on the subject, especially Link, J. Smith, Presl, Fée, and Moore, to propose dividing the genus into many genera, founded on the characters just referred to. But Mettenius has satisfactorily shown that the intermediate forms are so many and so perplexing, that the whole is best regarded as forming but one natural genus; and in this view he has been followed by Sir W. J. Hooker and Mr. Baker, who, however, retain in Polypodium those ferns which differ from Aspidium (or Nephrodium) only in the absence of an indusium,—a character which is often the result of accident or of arrested development. These species, nearly one hundred in number, constitute the genus Phegopteris, and are technically distinguished from the true Polypodia by having the stalks continuous with the rhizoma. The true Polypodia of the United States and Canadas are but eight in number. Three of these have the veins free,—P. Plumula, P. vulgare, and P. falcatum; two—P. Californicum and P. incanum—have the veins sometimes free, and sometimes sparingly reticulated; and three—P. Scouleri, P. aureum, and P. Phyllitidis—have the veins regularly reticulated, but in three different methods, representing respectively the sections Goniophhlebium, Phhlebodium, and Campyloneurum.

Plate XVI. — Polypodium aureum. The principal drawing represents a frond collected in Florida many years ago by Mr. S. B. Buckley; but the coloring is from living plants in Mr. Merrill's collection. A young plant, collected by Dr. Edward Palmer, is also figured; and the enlarged drawing shows the peculiar venation and the position of the sori.









### PLATE XVII. - FIGS. 1-8.

## BOTRYCHIUM SIMPLEX, HITCHCOCK.

### Hitchcock's Moonwort.

BOTRYCHIUM SIMPLEX: — Plant smooth, fleshy, not often over six inches high; sterile segment petioled, set near the base of the plant, rarely above the middle, varying from simple and roundish-obovate in small plants to triangular-ovate and deeplylobed, or even fully ternate with incised divisions in more developed forms; segments broadly obovate-cuneate or slightly lunate, the outer margin obscurely crenulate, sometimes lobed; veins flabellately forking; fertile segment once or twice pinnate.

Botrychium simplex, Нітснсоск, in Silliman's Journ., 1823, vi., p. 103, t. 8. Ноокек & Greville, Ic. Fil., t. 82 (right-hand figure). — Ноокек, Fl. Bor. Am., ii., p. 265. — Torrey, Flora of New York, ii., p. 507. — Gray, Manual, ed. i., p. 635; ed. v., p. 671. — Міlde, Nov. Act. Acad. Nat. Cur., xxvi., ii., p. 664, t. 49, 50, figs. 138–174 (t. 54, fig. 204, epidermis); Fil. Eur. et Atl., p. 197; Botr. Monogr., p. 137, t. 8, fig. 9; t. 9, figs. 4, 16 (details). — Davenfort, Notes on Botrychium Simplex, p. 5, etc., t. 1.

Botrychium Virginicum, var. (?) simplex, GRAY, Manual, ed. iii., p. 602. Botrychium Kannenbergii, "Klinsmann, in Bot. Zeitung, 1852, p. 378."—
"LASCH, in Bot. Zeitung, 1856, p. 606" (MILDE).

The following varieties are given by Milde in "Botrychiorum Monographia:"—

Var. simplicissimum, Lasch.—"Plant eleven lines to two and three-fourths inches high. Sterile lamina two lines long besides the petiole, elliptical or obovate, entire, the base cordate or narrowed into the petiole; spike composed of three to six sporangia."

Var. incisum, MILDE.—"Plant two inches or more high. Sterile lamina ovate or elliptical, incised, as much as nine lines long besides the petiole; the lobes one or two pairs. The common form."

Var. subcompositum, Lasch.—"Sterile lamina ovate-rotund; primary segments three or four pairs, the two or three upper pairs sessile, contiguous, nearly entire or incised, the lowest pair remote, narrowed at the base into petioles. A less common form."

Var. compositum, Lasch.—"Sterile lamina up to one inch long, ternate, or composed of three segments like the sterile lamina of var. incisum. Very rare."

Var. angustum, MILDE. — "Sterile lamina oblong, up to six lines long besides the petiole, segments two pairs, remote, erect-spreading, subspathulate from a narrower base."

Var. fallax, MILDE. — "Sterile lamina above the middle of the plant; otherwise as in var. incisum."

HAB.—In pastures and on hillsides from New Brunswick and New England westward to Lake Superior, Wyoming Territory, and California; also in Northern Kurope.

DESCRIPTION.—Plant of small size, varying in my specimens from barely an inch high to seven inches, but commonly about four inches high. The short root-stock is erect, as in the rest of the species of *Botrychium*, and bears at the top a peculiar bud, such as is described at p. 30 of this work. In the present species, this bud is usually enclosed in the dried sheathing bases

of the stalks of several former years, giving it an almost bulbous appearance. Mr. Davenport notices 1 that both the sterile and fertile segments are perfectly straight in the bud, and that the latter is smooth, as it is in all our species except B. ternatum and B. Virginianum. The common stem is usually very short, forming only from one-twelfth to one-fourth of the whole height of the plant: but it is occasionally longer in proportion; and in some of the specimens collected by Macoun near Lake Superior, and in a few of Mrs. Barnes's fine specimens from Northern New York, the common stalk forms fully one-half of the total length of the plant. In Milde's var. fallax, the common stalk is more than half. The whole plant is fleshy, - almost as much so as in B. Lunaria, and decidedly more so than in B. lanceolatum and B. matricaria folium. The sterile segment is distinctly petioled, the stalk being from one-fourth to three-fourths as long as the segment itself, rarely even equalling it. In very small plants the sterile segment is but three or four lines long, stalk included: it is then roundish-obovate, and nearly or quite entire (var. simplicissimum). In plants a little larger it is more ovate in shape, and three- to five- lobed (var. incisum). It becomes ampler in dimensions, — nine to twelve lines long, — and more decidedly

<sup>&</sup>lt;sup>1</sup> See an admirable paper by this excellent pteridologist on "Vernation in Botrychia," in the Bulletin of the Torrey Botanical Club for January, 1878. He discusses very carefully the differences in vernation in our several *Botrychia*, and gives also a concise statement of the distinctions which he has observed, illustrating them by several figures from Mr. Emerton's pencil. I find that on p. 39, supra, I have not given Dr. Milde sufficient credit for his observations on the buds of this genus.

pinnatifid, the lowest lobes well developed, and even slightly incised, in var. sub-compositum; and in the next stage, var. compositum, it is decidedly ternate, and consists of three stalked ovate-oblong divisions, which are pinnately lobed or incised. Var. angustum is simply a slender form, drawn out, perhaps, by growing in an unusually moist and shady place. The sterile segment is rounded at the apex, as are all the divisions and lobes.

The veins are dichotomous, or forking. The midrib of the sterile segment usually contains two slender vascular threads, and from these the veins for the lateral lobes branch off some little distance below the insertion of these lobes. The vein for each lobe forks just at the beginning of the narrowed base of the lobe, and continues to branch dichotomously; so that the lobe is well supplied with veinlets, but has no one special midvein.

The fertile segment considerably overtops the sterile, and varies, according to the size of the plant, from a simple spike to a fairly bipinnate panicle. The sporangia are commonly somewhat crowded, though more so in the shorter and more compound forms of the plant than in the slender and drawn-out specimens. All the *Botrychia* occasionally produce a few sporangia, or even a complete panicle, from some usually sterile portion of the plant; and *B. simplex* is no exception to this rule. The panicle may fork in the middle, or be divided down to its insertion on the common stem; or a second panicle may be borne on the sterile segment; or even some particular lobe of the sterile segment may bear a few sporangia. The spores are the largest of the genus, and are thickly dotted with minute points.

Mr. Davenport has sufficiently established the probability that some of the specimens on which President Hitchcock founded this species were really young plants of B. matricariæfolium: but the original figure and description point plainly to the B. simplex of recent authors; and two of the Conway plants, which were sent me from President Hitchcock's collection some years ago, are unmistakable simplex. One of them, with a perfectly simple sterile segment placed just below the middle of the plant, is represented at Fig. 2 of our Plate XVII.: the other, about the same size, has a three-lobed sterile segment near the base of the plant.

This fern was very scantily represented in American herbaria until about thirteen years ago, when Professor J. A. Paine began to collect it in Oncida County, New York, and Professor Sidney I. Smith brought fine specimens from Maine. At a time when B. lanceolatum and B. matricariæfolium were not recognized as American plants, every little Botrychium was thought to be the simplex; and hence the descriptions given of it in the various manuals of botany were made wide enough to include the other species also. But the character given by Dr. Torrey, in "The Flora of New York," is very clear: "Frond from the lower part of the scape, oblong, irregularly three- to four- lobed or pinnatifid, with the segments roundish, obovate, cuneate, and entire or somewhat incised; spike pinnate."

In Dr. Milde's various papers, and especially in Mr. Davenport's monograph on *Botrychium simplex*, may be found very full accounts of the history of this little fern, together with a careful review of its relationship to other allied species, and its distinctions from them. From B. Lunaria it is distinguished by the more decidedly petioled sterile segment, commonly placed low down on the plant, so that it seems almost to grow separately from the root-stock. The tendency towards the production of a ternate sterile segment in well-developed plants also separates it from B. Lunaria. From B. lanceolatum and B. matricariafolium, the same basal or nearly basal position of the sterile segment distinguishes it; as does also the flabellately-dichotomous, rather than sub-pinnate, character of its venation. From all of them the perfectly straight vernation and the character of the spores also separate it satisfactorily.

Stations for this fern have been reported in Maine, Massachusetts, Vermont, Northern New York (abundant and fine specimens, showing all or nearly all the forms, have been collected and freely distributed by Mrs. Barnes and Rev. J. Herman Wibbe 1), and in the Highlands, on Long Island (Mr. E. S. Miller), near Lake Superior (Mr. Macoun), in Yellowstone Park (Dr. Parry), and in several places, at high elevations, in the Sierra of California (Mr. J. Muir, Miss Pelton, Dr. Gray). The Western specimens have a stocky, condensed habit, and belong to the more compound forms of the species.

While I have given Dr. Milde's "varieties," with translations of his characters, I am entirely of the opinion expressed by Mr.

<sup>&</sup>lt;sup>1</sup> Dr. Wibbe's plants are from a sandy hill, called Lewis's Bluff, on the shore of Lake Ontario, six miles west of Oswego. Mrs. Barnes's specimens were mostly collected in what is called "The John Brown Tract."

Davenport, that the form called "compositum" is the true form of the perfectly matured plant, and that all the other forms are merely undeveloped conditions, and do not present those permanent differences which are characteristic of varieties in the proper sense of the term.

Plate XVII., Figs. 1-8. - Botrychium simplex.

Fig. 1. — A plant from Re '. J. H. Wibbe, representing var. sub-compositum: the sterile segment higher up than usual, and the panicle forked.

Fig. 2. — Var. simplicissimum. A plant sent from President Hitchcock's herbarium, collected in Conway, Massachusetts.

Fig. 3.—Var. sub-compositum, from Dr. Wibbe. A plant of unusual stature, bearing a second spike rising from near the base of the sterile segment.

Fig. 4. - Var. incisum. A specimen in Mr. Davenport's herbarium.

Fig. 5. — The fully-developed typical form, var. compositum. From Yellowstone Park, Dr. Parry.

Fig. 6. — A bud, the old sheathing stalk removed, showing the erect vernation.

Fig. 7. — A lobe of a sterile segment, showing the forked veinlets.

Fig. 8.—A spore. Figs. 6 and 7 are moderately enlarged; Fig. 8, highly magnified. The others are of the natural size.



PLATE XVII. - Figs. 9-14.

# BOTRYCHIUM MATRICARIÆFOLIUM, AL. BRAUN.

## Matricary Grape-Fern.

Botrychium matricariæfolium: — Plant two to twelve inches high, moderately fleshy; sterile segment borne high up on the common stalk, distinctly petioled or rarely sessile, membranaceous, oblong, ovate, or even deltoid in outline, in simpler forms pinnately divided or lobed into a few nearly equal oblong or ovate or rounded entire or crenated obtuse lobes, but in larger forms twice pinnatifid, the primary divisions several pairs, the lowest ones largest, and all pinnatifid into oblong-ovate toothed and obtuse lobes; midvein of the lobes usually distinct, and bearing on each side forking veinlets; fertile segment short-stalked, varying from a simple spike to an ample panicle of racemed sporangia.

Botrychium matricariæfolium, Al. Braun, in Doell, Rheinische Flora, p. 24

(1843). Koch, Syn. Fl. Germ., ed. ii., p. 972; ed. iii., p. 729.—

Milde, Nov. Act. Acad. Nat. Cur., xxvi., ii., p. 679, t. 51, figs. 182–188, t. 52, figs. 189–196, p. 761, t. 55, figs. 5–8; Fil. Eur. et Atlant., p. 195; Botr. Monogr., p. 123, t. 8, fig. 2, t. 9, figs. 7, 17.

— E. Hunt, in Bulletin of the Torrey Botanical Club, iii., p. 33.

— Davenport, Notes on Botr. simplex, p. 17, t. 2, figs. 7, 8, 10–12, 30, 32–43; and in Bull. Torr. Club, vi., p. 196, etc., t. 1, fig. 6.

Botrychium rutaceum, Swartz, "in Schraders Journ. Bot. 1800, ii., p. 110, in part;" Syn. Fil., p. 171, in part. — Newman, History of British Ferns, ed. iii., p. 320. — Moore, Index Filicum, p. 211. [Here may be found abundant references to works in which this plant is referred to or described.]

Botrychium simplex, Hooker & Greville, Ic. Fil., t. 82, left-hand figure. [The B. simplex of American writers generally included this species with the true simplex.]

Botrychium simplex, var. bipinnatifidum, GRAY, in Amer. Nat. Aug. 1875.

Botrychium neglectum, Wood, Class-Book of Botany, ed. of 1851, p. 635

(and perhaps earlier editions which I have not seen).

HAB. — Dark, wet woods, and in beds of moss along rivulets: from New Hampshire, Professor Wood, Miss Haskell, G. B. Putnam; Vermont, Mrs. L. V. Morgan, C. G. Pringle; and Massachusetts, Rev. H. G. Jesup, etc.; to New York, especially Northern New York, E. Hunt, Professor Paine, Mrs. Barnes, etc.; Pennsylvania, Professor Porter; and Lake Superior, H. Gillman, Macoun; Dutchess County, New York, L. H. Hovsradt. Canada, Unalaska, and Europe, from Westrobothnia to Italy.

Description. — This species of grape-fern or moonwort is commonly a somewhat larger plant than the kind last described. Though the smallest specimens are only two inches high, yet the average height of fair specimens is six or eight inches, and a few in my collection are fully ten inches high; while Mr. Davenport says, "two to twelve inches high, rarely more." As in B. lanceolatum, to which this species is most nearly related, the greater part of the whole height consists of the common stalk, though the relative proportion of common stalk is subject to considerable variation. The stalk is rarely as little as one-half of the

whole, more commonly two-thirds to three-fourths, and sometimes as much as five-sixths. It is either slender or moderately stout, usually fleshy, and somewhat enlarged at the base, where it encloses the bud for the growth of the next year or two. The bud is smooth, and in it "the apex of the fertile frond is bent downward toward the sterile frond, which clasps it with its side divisions, and bends its apex downwards over the whole" (Davenport). The sterile segment is extremely variable in shape, so that Milde has based several "varieties" on the diversities which it presents; but as these seem to be only indicative of stages of development, and not variations transmissible to successors, they are, perhaps, best omitted. In the smallest examples the sterile segment is scarcely three lines long, obovate-cuneate, and slightly three- to five- toothed along the sides. Such specimens were for a long time marked B. simplex in American herbariums, and it is very probable that a portion of President Hitchcock's original plants were of this sort. In somewhat larger plants the sterile segment is one or two inches long, oblong-ovate in outline, and has a petiole a third of its own length. The petiole is continued upwards into an often narrowly-winged midrib, which bears on each side three, four, or five ovate or oblong-ovate obtuse lobes, more or less toothed or incised, but nearly all of one size. This is the commonest form of the species in America, and is represented by the figure in Hooker and Greville's Icones Filicum, cited above. Professor Wood's B. neglectum, a specimen of which he most kindly placed at my disposal, is also this form of the species.

<sup>&</sup>lt;sup>1</sup> It should be noticed that Professor Wood was the first American botanist to separate this species from *B. simplex*.

In the most fully-developed form the sterile segment is triangular in outline, about three inches long, and two and a half inches wide at the base. There are about five pairs of primary divisions, the lowest, of course, much the largest, and the others successively smaller. These lowest divisions are an inch to an inch and a half long, six to eight lines wide, and are pinnately divided into four to six pairs of oblong or ovate more or less toothed obtuse lobes. The next two or three primary divisions are also pinnately divided; but the lobes are smaller, and either obscurely toothed or entire, and the uppermost primary divisions are merely toothed lobes. Thus the sterile segment is broadly triangular and bipinnatifid. The fertile segment is also ample, and has the lower branches nearly as long as the central portion.

The lobes have a rather faint midvein; which, however, is lost in the forking oblique veinlets about the middle of the lobe. The lowest veinlets separate from the midvein at the very base of the lobe, or even below it in the rachis. The spores are thickly sprinkled with roundish warts.

The name *B. rutaceum* was applied by Swartz, mainly to a form of *B. ternatum*, but incidentally to this species also. It was to remedy the resulting confusion that Professor Braun proposed for the present plant the new specific appellation of *matricarioides*, referring to the resemblance of the sterile segment to the leaves of *Matricaria Parthenium* (Linnæus). It was, however, according to Koch, as long ago as 1678, called *Lunaria racemosa minor Matricariæ folio* by Breyne (Cent., p. 184, t. 94).

In Dutchess County, New York, as Mr. Hoysradt informs us,

the matricary grape-fern fruits in the latter part of June or early in July, and the empty sporangia are shrivelled by the time that *B. lanceolatum* is mature. Other persons make a similar report; so that there can be no doubt that the species now under consideration is from two weeks to a month earlier in maturing than the other.

This species is, however, more closely related to *B. lanceolatum* than to any other of our grape-ferns: and, indeed, the two are united as one species by several authors of high reputation; as, for instance, by Mr. Baker in the "Species Filicum," and by Moore in his various writings. To redeem the promise made on p. 36 of the present work, the differential characters of the two species are indicated in parallel columns:—

#### B. LANCEOLATUM.

Sterile segment sessile, spreading at a wide angle, deltoid even in small plants,

Divisions and lobes lanceolate and sub-acute.

Midvein of lobes continuous nearly to the apex.

Panicle with a very short stalk.

"Bud with the fertile segment recurved its whole length, and the

#### B. MATRICARIÆFOLIUM.

Sterile segment petioled, diverging but little, and embracing the fertile when young; oblong, and only in the largest plants deltoid.

Divisions and lobes oblong or ovate and obtuse.

Midvein dissipated in the middle of the lobes.

Panicle with a stalk usually half as long as the sterile segment, and sometimes longer than it.

"Bud with the apex of both segments turned down, the sterile shorter sterile frond reclined upon it" (Davenport).

segment clasping the fertile, and its apex overlapping the whole" (Davenport).

Time of fruiting, July and August.

Time, two or three weeks earlier than the other.

Plate XVII., Figs. 9-14. — Botrychium matricariæfolium.

Fig. 9 is a plant of small size, though not so small as is sometimes seen. It is from Bethlehem, New Hampshire, collected by Mr. Granville B. Putnam.

Fig. 10, a large and fully-developed specimen from near Utica, New York, collected by Mr. Edwin Hunt.

Fig. 11 shows the commonest form. The specimen is from Mrs. Hathaway, who collected it in Otsego County, New York.

Fig. 12 represents the vernation, Fig. 13 the venation, of a roundishovate segment, and Fig. 14 a spore.

More decidedly ternate forms than Fig. 10 have been found in Lewis County, New York, by Mrs. Barnes, some of them with the sterile segment bearing scattered sporangia.







### PLATE XVIII.

# ADIANTUM PEDATUM, LINNÆUS.

### American Maiden-hair.

ADIANTUM PEDATUM:—Root-stock creeping, scaly, and copiously rooting; stalks scattered, a foot or more high, dark-brown and polished, forked at the top; fronds six to fifteen inches broad, membranaceous, smooth, spreading nearly horizontally, composed of several (six to fourteen) slender divisions radiating from the outer side of the recurved branches of the stalk, and bearing numerous oblong or triangular-oblong short-stalked pinnules having the lower margin entire and often slightly concave, the base parallel with the polished hairlike rachis, the upper margin lobed or cleft and bearing a few oblong-lunate or transversely linear reflexed involucres; sporangia on the inner surface of the involucres (as in all *Adianta*), borne on the extended apices of the free forking veinlets, which proceed from a principal vein closely parallel to the lower margin of the pinnule.

Adiantum pedatum, LINNÆUS, Sp. Pl., p. 1557. — THUNBERG, Flora Japonica, p. 339. — SWARTZ, Syn. Fil., p. 121. — SCHKUHR, Krypt. Gew., p. 107, t. 115. — WILLDENOW, Sp. Pl., v., p. 438. — MICHAUX, Fl. Bor. Am., ii., p. 263. — PURSH, Fl. Am. Sept., ii., p. 670. — TORREY, Fl. of N. Y., ii., p. 487. — GRAY, Manual. — RUPRECHT, Distrib. Crypt. Vasc. in Imp. Ross., p. 49. — HOOKER, Sp. Fil., ii., p. 28. — BRACK-ENRIDGE, Filices of the U. S. Expl. Exped., p. 100. — EATON, in

Parry's Exped. to Japan, ii., p. 329. — MAXIMOWICZ, Primitiæ Fl. Amurensis, p. 341. — METTENIUS, Fil. Hort. Lips., p. 47; Prolusio Fl. Japon. in Ann. Mus. Bot. Lugd.-Batav., iii., p. 171. — HOOKER & BAKER, Syn. Fil., p. 125. — MILDE, Fil. Eur. et Atl., p. 31. — KEYSERLING, Gen. Adiantum, in Mem. Acad. Petrop., ser. vii., xxii., No. 2, pp. 5, 28.

Adiantum Americanum, Cornutus, Canad. Pl. Hist., p. 7, t. 6 (1635).

Maiden Hair, or Cappellus veneris verus. Josselyn, New Englands Rarities Discovered, p. 55 (1672).

Adiantum fronde supra-decomposita bipartita, foliis partialibus alternis, foliolis trapeziformibus obtusis, Gronovius, Flora Virginica (1739), p. 123. (For other ancient references see Linnæus, as quoted above.)

Adiantum boreale, PRESL, Tent. Pterid., p. 158.

HAB.—In rich, moist woods, especially among rocks. Common from New Brunswick and Canada southward to Central Alabama, Professor Eugene A. Smitti, and westward to Lake Superior, Wisconsin, and Arkansas. Also in Utah, California, Oregon, British Columbia, the islands of Alaska, Kamtschatka, Japan, Mantchooria, and the Himalayan provinces of India. Ruprecht speaks of specimens from Newfoundland, and Professor Gray informs me that it exists in De La Pylaie's collection from that island.

DESCRIPTION.—The root-stock is elongated and creeping. It is about the diameter of a goose-quill, is covered with minute ovate scales, roots copiously from beneath and along the sides, and produces fronds from the right and left sides alternately. The stalks are usually from a foot to fifteen inches high, and from half a line to a line in thickness. When very young, they bear a few scattered narrow scales; but these soon fall off, leaving

minute pointed scars. The mature stalk is roundish in section, the convexity being greatest on the side which corresponds to the under surface of the frond. The two convexities, anterior and posterior, are separated by two obscure angles or ridges, which extend the whole length of the stalk. The anterior, or flatter, convex surface is nearly black, while the other side is a dark purplish brown. The fibro-vascular bundle is U-shaped near the base of the stalk; but higher up it is more like a broad, open V; and just below the forking of the stalk it separates into two portions. The two branches of the stalk diverge at an angle of about fifty degrees, and rise obliquely, gracefully recurving till they nearly meet again. From the outer side of the curve each branch sends out from two to seven slender diverging branchlets, which are the rachises of the pinnæ. The branchlets nearest the forking of the stalk are from four to fifteen inches long, those more remote successively shorter. Thus the whole frond is from five or six to fifteen or eighteen inches broad, and, while somewhat funnel-form in the centre, radiates nearly horizontally towards the circumference. A pressed specimen can give but little idea of its graceful position.

The pinnules, or leaflets, are from six to twelve lines long, and three or four broad, and are placed alternately on the rachises of the pinnæ. They are very numerous, seldom fewer than twelve on each side of one of the middle (or lower) rachises, and in large fronds sometimes as many as forty on each side. The outer rachises bear fewer and fewer pinnules, and the outermost of even a very large frond will not have more than eight or ten on each

side. They are attached to the rachis by a very short and slender stalk. Their usual form is dimidiate-oblong; that is, they appear as if cut in two longitudinally, and the lower half removed, so that the lower edge is entire, and straight, or often slightly hollowed; the base, or edge nearest the rachis, is also straight and entire; it is parallel with the rachis, or even overlaps it a little; the upper edge is more or less lobed or incised, but in general nearly parallel with the lower, and the end is rounded and slightly lobed. The point of attachment is, of course, at the angle between the lower and basal edges. The terminal pinnule of each pinna, and the basal one, which, indeed, very often proceeds from one of the recurved branches just below the origin of the pinna, are broadly cuneate or transversely oblong in shape, the two sides which meet at the point of attachment being equal; and the few pinnules near the basal one are shorter and more triangular than the middle ones. The texture is delicately membranaceous, but elastic; the color is a lively green, and both surfaces are very smooth. The upper surface appears to be destitute of stomata; and this may be the reason why water will not adhere to the pinnules, but either falls off, or stands in spheroids ready to fall. The veins are free: in the symmetrical basal and apical pinnules the veinlets fork repeatedly from the very base; but in the oblong middle pinnules there is a faint principal vein running close to the lower edge; and from this the veinlets diverge obliquely, and fork about three times before reaching the superior margin. The incisions of the superior margin are usually very narrow, and extend only to about one-third of the breadth of the pinnule; but in some specimens from California and Oregon they are wider and considerably deeper. The lobes are from four to six or seven in number: in sterile fronds they are minutely toothed at the end; but in the commoner fertile fronds they are reflexed and changed in character, so as to form somewhat crescent-shaped or transversely elongated involucres of a pale-brownish color. The tips of the veinlets extend into these involucres, and bear the sporangia on the under or inner surface. In this peculiarity is the essential generic character of Adiantum. The spores of this species are spheroid-tetrahedral, the three radiating angles marked with slender vittæ, or bands. They are mature in the latter part of summer; but the fronds remain until frost, often changing from green to variegated shades of brown.

There do not seem to be any well-marked variations in this fern. Ruprecht has a "var. *Alenticum*," the *Ad. boreale* of Presl, separated mainly on account of its smaller size and fewer parts.

The genus Adiantum contains eighty-three species, according to Mr. Baker's estimate; but this number is reduced to sixty-seven by the more recent and very careful recension of Keyserling. The species vary in form from a simple and reniform frond an inch or two in diameter to others with ample tripinnate and even quadripinnate fronds. The species with distinctly bipartite and radiated fronds are Ad. patens, hispidulum, and flabellulatum. A. patens is found in Mexico and Central America. It is a smaller plant than A. pedatum, and has deeply-sunken reniform involucres. The other two occur in South-eastern Asia, the hispidulum extending to Africa and to New Zealand, and the fla-

bellulatum to Japan: the former has hispid surfaces and small roundish involucres; and the latter has rusty-fibrillose rachises, coriaceous pinnules, and transversely oblong sub-confluent involucres. Ad. patens follows the form and branching of our fern very closely; but the two Old-World species often depart from it, and show a tendency to develop branches on one or other of the longest pinnæ, thus indicating an approach towards a pyramidal structure of the frond.

The remaining Adianta of the United States are Ad. Capillus-Veneris (Linnæus), found from North Carolina to California; Ad. emarginatum (Hooker), which is the Ad. Chilense of American botanists, but not of Kaulfuss, found in California and Oregon; and Ad. tricholepis (Fée), which occurs in Texas and California, and extends southwards to Central America.

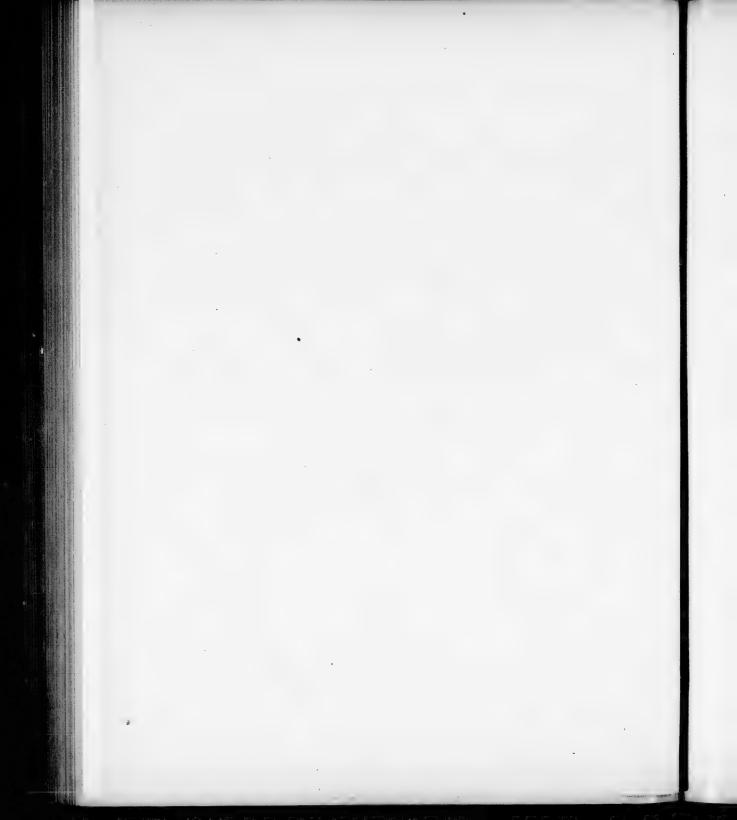
The American Maiden-hair is easily cultivated, and will grow very freely either in a shaded corner of a garden or in the house, and is perhaps more elegant and graceful than any other of our ferns, the climbing-fern scarcely excepted. Josselyn evidently mistook it for the Venus-hair, one of the chief ingredients in a syrup which was formerly a famous remedy for nearly all ailments, and said, "The Apothecaries for shame now will substitute Wall-Rue no more for Maiden Hair, since it grows in abundance in New-England, from whence they may have good store."

Mr. Emerton's figure is taken from a living plant, and shows the frond as it appears before it has been flattened in a collector's portfolio.









### PLATE XIX.

# BLECHNUM SERRULATUM, RICHARD.

### Florida Blechnum.

BLECHNUM SERRULATUM: — Root-stock creeping, or suberect, woody, covered like the bases of the stalks with fine narrow fuscous-brown chaff; stalks scattered or somewhat clustered, rigid and nearly smooth, six to eighteen inches long; fronds oblong-linear, one to three feet long, pinnate; pinnæ very numerous, sessile, joined to the rachis by a distinct articulation, coriaceous, smooth and glossy above, minutely chaffy beneath along the midrib, finely serrulate along the margin, the terminal one distinct; sterile ones elliptical or linear-oblong, rounded at the base, and barely pointed at the apex; veins oblique to the midrib, crowded, forked at the base, free; fertile pinnæ narrower and more acute, bearing the sporangia on a special receptacle closely parallel to the midrib; involucres attached to the receptacle outside the sporangia, free along the inner edge, at length reflexed.

Blechnum serrulatum, Richard, in "Act. Soc. Hist. Nat. Par. i., p. 114."—

Міснаих, Fl. Bor. Am., ii., p. 264. — Swartz, Syn. Fil., p. 113. —

Schkuhr, Krypt. Gew., p. 100, t. 108. — Willdenow, Sp. Fl., v.,
p. 411. — Pursh, Fl. Am. Sept., ii., p. 669. — Меттеліиз, Fil.

Hort. Lips., p. 63. — Hooker, Sp. Fil., iii. p. 54. — Еатон, in

Chapman's Flora of Southern U. S., p. 591. — Grisebach, Fl.

Brit. W. I. Is., p. 673. — Ноокек & Вакег, Syn. Fil., p. 186. —

Bentham, Fl. Austral., vii., p. 739.

Blechnum angustifolium, WILLDENOW, Sp. Pl., v., p. 414.

Blechnum calophyllum, Langsdorff & Fischer, Ic. Fil., p. 20, t. 23.— Willdenow, Sp. Pl., v., p. 415.—Brackenridge, Ferns of U. S. Expl. Exped., p. 132.

Blechnum stagninum, RADDI, Fil. Bras., p. 54, t. 62.

Blechnum striatum, R. Brown, Prodr., p. 152.—Hooker, Sp. Fil., iii., p. 55, t. 159.

Blechnopsis serrulata, PRESI., Epim. Bot., p. 119.

HAB.—In wet places, chiefly along streams and about ponds, apparently not rare in Samuthern part of Florida, Michaux, Buckley, Bunstead, Palmer, Gardelle, etc. West Indies and Central America to Southern Brazil. Also in Malacca and various parts of Australia.

Description.—The root-stock is hard and woody, at least when dried. It is from a third to half an inch thick, and creeps apparently below the surface of the ground, but occasionally rises at the advancing end. It is covered with fine fuscous-brown chaffy scales, which also ascend the stalks a short distance. The stalks are continuous with the root-stock, and are developed from the growing extremity, but remain in position while the root-stock advances a few inches beyond them. They are commonly more than a foot high, nearly as thick as a writing-quill, smooth, and very rigid. There is a deep channel extending all along the anterior side, and continuing along the rachis to the topmost pinna. The color of the stalks in dried specimens is a palish fuscous-brown. A section of the stalk shows about five subcylindrical fibro-vascular bundles arranged in a semicircle. The fronds in the Florida specimens are from a foot to a foot and a

half long; but Hooker gives the extreme as three feet. Their general outline is oblong-linear, tapering somewhat toward the apex, and occasionally a little toward the base also. They curve away from the erect position very gracefully, so that the apex often droops a little, and, growing in their native swamps, must constitute objects of great beauty. They are rigidly coriaceous, glossy above, and somewhat paler beneath, and simply pinnate with very numerous often imbricated sessile pinnæ, which are attached to the rachis by an evident articulation, and leave a slightly elevated ovate scar when detached.

The sterile pinnæ are elliptical or linear-oblong, with a rounded or obtusely cuneate often unequal base, and an obtusely pointed rarely acute apex. They measure from two to four inches in length, and about half an inch in breadth. The midrib is straight, and slightly channelled above, but very prominent beneath, where it is commonly furnished with a few little ovate scales. The edge is very finely serrulate with cartilaginous teeth. The veins are placed very close together, are frequently forked close to the midrib, but are uniformly free, and are most prominent on the upper surface, giving it a finely striated appearance.

The fertile pinnæ are usually confined to the upper half of the frond: they are narrower and often longer than the sterile ones, and consequently more cuneate at the base, and more acute at the apex.

The venation differs from that of the sterile pinnæ in that the veinlets are reticulated so as to form a series of elongated narrow areoles following closely along each side of the midrib: outside of these areoles the veinlets run obliquely to the margin, as in the sterile pinnæ.¹ A special line-like receptacle is formed on the under surface nearly following the outer boundary of these areoles, but not exactly coinciding with it. This receptacle bears abundant sporangia, and outside of them a long and narrow involucre, which is free along its inner margin, and at first covers the sporangia, but is pushed back as they mature, and is at length reflexed.

This band of sporangia each side of the midrib, covered at first by a special involucre which is remote from the margin of the frond, is characteristic of the genus *Blechnum*. The venation of the fertile pinnæ varies somewhat in the different species. About twenty species are now recognized: more than half of them are natives of tropical or south-temperate America; and the rest are found in the East Indies, in Africa, in Australia, or in Polynesia. One species has onen simple lanceolate fronds; a few have pinnatifid fronds; several, like our plant, have pinnate fronds; and one has very much elongated bipinnate fronds, with the climbing and twining habit of a *Lygodium*. This species, *B. volubile* (Kaulfuss), occurs in the West Indies and South America, and has been considered the type of a separate genus (*Salpichlæna*) by John Smith and Presl.

The genus *Blechnum*, with *Lomaria*, *Sadleria*, of the Hawaiian Islands, *Woodwardia* and *Doodya*, compose the tribe *Blechnea* or *Lomariea*, a group which is intermediate between

<sup>&</sup>lt;sup>1</sup> To see these areoles, remove the sporangia and the involucre from a fertile pinna, and view it with a strong lens by transmitted light. The areoles may also be seen faintly from the upper surface by reflected light.

Pterideæ and Asplenieæ, and is characterized by having more or less elongated sori parallel to the costa, either near it or remote from it, but not properly marginal, and provided with a special involucre attached to the receptacle outside the sorus, and opening along the edge nearest the costa. Lomaria approaches Pterideæ with inconvenient closeness, and is referred to that group by Mr. Baker; while by Mettenius it was united with Blechnum, and put in his tribe Asplenieæ.

Sadleria is probably peculiar to the Hawaiian Islands. The plants have erect trunks a few feet high, and large coriaceous fronds, with numerous elongated pinnatifid pinnæ. The sori are arranged like those of Blechnum along each side of the midveins of the segments, and there are narrow paracostal areoles like those of Blechnum serrulatum, but the indusium is more coriaceous and persistent. The number of species is uncertain: there are at least two, and may be three or four; but it is impossible to decide without better and ampler specimens than have as yet been sent from those islands. Woodwardia is represented in the United States by three species; and Doodia consists of a few species with small-sized fronds, and fructification much like that of Woodwardia.

The Florida Blechnum was discovered first by Michaux upon the banks of the stream *Aisa-hatcha*. It was not collected again for many years until rediscovered somewhere in East Florida by Mr. S. B. Buckley. It has since been found by many travellers, and is now well known in herbaria. Mr. Merrill has had it in successful cultivation at Cambridgeport for some

time, and it is also cultivated in the Botanical Gardens at Kew.

This is the only species of the genus, I believe, in which the pinnæ are plainly articulated to the rachis; and, although it has been described from different and often remote localities under several more names than are repeated in the synonymy given above, all the names have been shown to belong to one plant.

Plate XIX. — Blechnum serrulatum, much reduced, from a living plant in the ferneries of Hon. J. Warren Merrill, at Cambridgeport, Mass. The plant was brought from Southern Florida. An entire sterile frond of the natural size, with a portion of the root-stock, is represented in outline, and two fertile pinnæ, one of them colored, and showing the continuous band of fruit.

• Since these pages have been in type, Dr. Garber has sent pinnæ, over six inches long, which were taken from "fronds four or five feet long."









# PLATES XX AND XXA.

# BOTRYCHIUM TERNATUM, SWARTZ.

# Ternate Grape-Fern.

BOTRYCHIUM TERNATUM: — Plant fleshy, sparsely hairy or nearly smooth, usually from four to twelve inches high; sterile segment long-petioled from near the base of the plant, broadly deltoid, ternate, variously decompound; primary, secondary, and even tertiary divisions stalked; ultimate divisions from round-ish-reniform to obliquely ovate or ovate-lanceolate, crenulate or toothed or incised; fertile segment twice to four times pinnate, usually much taller than the sterile; bud pilose.

Botrychium ternatum, SWARTZ, in Schraders Journal, 1800, ii., p. 111; Syn. Fil., p. 172. — WILLDENOW, Sp. Pl., v., p. 63. — KUNZE, Pteridographia Japonica, in Bot. Zeit., vi. (1848), p. 491; Die Farrnkräuter, ii., p. 51, t. 121. — METTENIUS, Prolus. Fl. Japon., in Ann. Mus. Bot. Lugd.-Batav., iii., p. 182. — MILDE, Fil. Eur. et Atl., p. 199; Botr. Monogr., p. 146, t. vii., figs. 7, 13, 14, 18, 19, viii., figs. 3, 4, 5, 7, 8, 12, ix., figs. 5, 23–29 (various details of form and structure). — Hooker & Baker, Syn. Fil., p. 448. — Davenport, in Torrey Club Bull., vi., p. 196.

Osmunda ternata, Thunberg, Fl. Japon., p. 329, t. 32 (1784).

\* To one form or another of this species are to be referred the following synonymes:—

Botrypus lunaroides, MICHAUX, Fl. Bor. Am., ii., p. 274.

- Botrychium lunaroides, Swartz, Syn. Fil., p. 172.
- Botrychium lunarioides, Torrey, Fl. New York, ii., p. 506.—Gray, Manual, ed. i., p. 635, etc.—Eaton, in Chapman's Flora, p. 599.
- Botrychium rutaceum, Swartz, in Schraders Journal, 1800, ii., p. 110 (in part); Syn. Fil., p. 171 (in part).—Schkuhr, Krypt. Gew., p. 157 (in part), t. 155, fig. a.
- Botrychium fumarioides, Willdenow, Sp. Pl., v., p. 63. Pursh, Fl. Am. Sept., ii., p. 655. Brackenridge, Fil. U.S. Expl. Exped., p. 316.
- Botrychium obliquum, Muhlenberg, in Willdenow, Sp. Pl., v., p. 63.— Pursh, Fl. Am. Sept., ii., p. 655.— Ноокег, Fl. Am. Bor., ii., p. 265.— Fournier, Mex. Pl., Crypt., p. 141.
- Botrychium dissectum, Sprengel, Anleitung, p. 172 (Engl. version, p. 187).

   Минlenberg, in Willdenow, Sp. Pl., v., p. 64. Schkuhr, Krypt. Gew., p. 159, t. 158. Pursh, Fl. Am. Sept., ii., p. 656.
- Botrychium matricarioides, WILLDENOW, Sp. Pl., v., p. 62. PRESL, Suppl., p. 44. Moore, Index Filicum, p. 210.
- Botrychium australe, R. Brown, Prodromus, p. 164.
- Botrychium silaifolium, PRESL, Relig. Haenk., i., p. 76; Suppl. p. 45.
- Botrychium decompositum, Martens & Galeotti, Syn. Fil. Mex., p. 15, t. 1.

   Liebmann, Mex. Bregn., p. 153.
- Botrychium rutæfolium, Al. Braun, "in Doell, Rheinische Flora, p. 24."—
  Koch, Syn. Fl. Germ., "ed. ii., p. 972," ed. iii., p. 729.— Milde,
  Nov. Act. Acad. Nat. Cur., xxvi., ii., p. 690, t. 53, figs. 197–200,
  t. 54, fig. 207, t. 55, fig. 9.
- Botrychium sub-bifoliatum, Brackenridge, Fil. U. S. Ex. Ex., p. 317, t. 44. Botrychium cicutarium, J. D. Hooker, Handbook of N. Zeal. Flora, p. 387 (not of Swartz).

The most distinct of the many North-American forms of this variable species may be arranged thus:—

Var. lunarioides: - Plant of small size; sterile segment thrice or four

times ternate; ultimate divisions, roundish-reniform; veinlets flabellately forking.

Botrypus lunaroides, Michaux, 1. c. — Botrychium ternatum, C) Americanum, α. lunarioides, Milde, Botr. Monogr., p. 162.

Var. ruta folium: — Plant of small size; secondary divisions of the sterile segment oblong-ovate, rather obtuse, or barely pointed, near the base cut into a few short lobes having their base very unequal, cordate on the lower side, rounded or sub-truncate on the other, the margin entire or sparingly crenate.

Botrychium rutæfolium, Al. Braun, î. c. — B. ternatum, A) Europæum, MILDE, Botr. Monogr., p. 148.

Var. australe: — Plant ample, often very large; sterile segment decompound; tertiary or quaternary divisions ovate-oblong, sub-acute, pinnatifid; ultimate segments broadly ovate or roundish-rhomboid, the base rounded on the lower side, and erect or truncate on the other; margin crenulate or denticulate; veins diverging from a midvein. The fully developed typical form of the species: — .

Botrychium australe, R. Brown, I. c. — B. decompositum, Martens & Galeotti, I. c. — B. ternatum, B) Australasiaticum, a. vulgare, Milde, Botr. Monogr., p. 157.

Sub-var. intermedium: — Rather less in size than australe, the ultimate segments fewer and smaller.

B. lunarioides, GRAY, Manual of Botany (not Botrypus lunarioides of Michaux).

Var. obliquum:—Plant small or large; sterile segment with ovatelanceolate pointed pinnatifid secondary or tertiary divisions, the lower segments of them roundish or obliquely ovate, the margin crenulate or toothed; veinlets diverging from a midrib. Botrychium obliquum, Muhlenberg, l. c. — B. lunarioides, var. obliquum, Gray, l. c. — B. ternatum, C) Americanum, β. obliquum, Milde, Botr. Mon. p. 163.

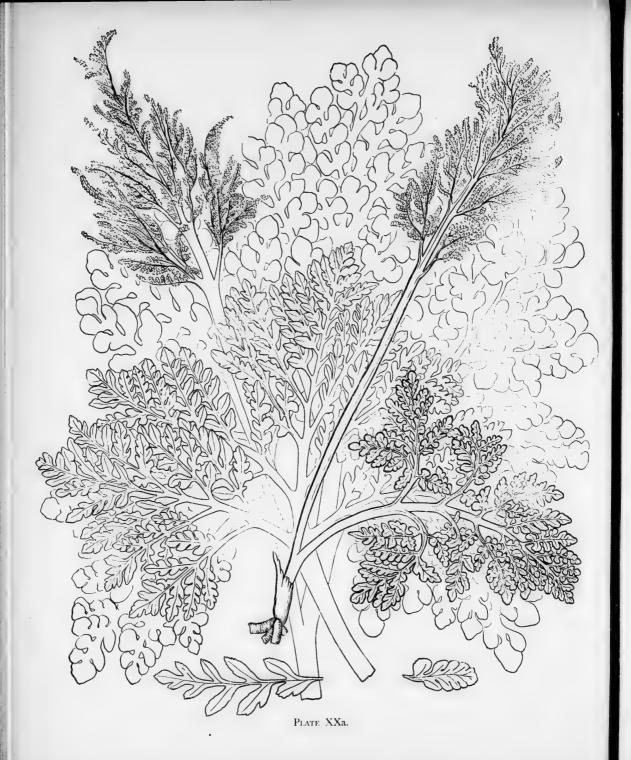
Var. dissectum: — Plant usually ample; sterile segment decompound; secondary or tertiary divisions ovate-lanceolate, pointed, cut into innumerable very narrow ultimate segments or teeth, which receive solitary veinlets. Botrychium dissectum, Sprengel, l. c.; Muhlenberg, l. c. — B. lunarioides, var. dissectum, Gray, l. c. — B. ternatum, C) Americanum, γ. dissectum, Milde, Botr. Monogr., p. 164.

HAB.—In pastures and on hillsides, sometimes in woods also, from Newfoundland to Unalaska in the North, and extending southward to Florida and California. Also found, in one form or another, in Northern and Central Europe, Northern Asia, Japan, the Hawaiian Islands, New Zealand, Australia, and from Mexico to New Granada and Venezuela.

DESCRIPTION. — The ternate grape-fern presents greater differences in size, and wider variations in the form and cutting of the divisions of the sterile segment, than any other species of the genus. The plant varies from barely one inch to nearly a foot and a half in height, though it but rarely touches either of these extremes.

The root-stock is cord-like, a few lines or an inch or two in length, bearing fascicled roots chiefly just below the terminal bud. The roots are dark-colored, sparingly branched, fleshy, and full of starch-granules. Very often they have a knotted or densely annulate appearance. As the axis of growth elongates from year to year by the development of new fronds, new roots are formed, and some of the older ones perish, though others of them remain apparently for several years.





The bud differs from those of the smaller species already described in being always decidedly pilose or hairy. Like those, however, it is completely enclosed in the hollowed base of the stalk; and in it may be distinctly seen the rudiment of the fronds for the two or three following years. Mr. Davenport finds that the apices of both the sterile and fertile segments are bent downwards, and have a slight inward curve. (See his paper in the Bulletin of the Torrey Club.)

The common stalk is very short, being usually only from one-tenth to one-sixth of the whole length of the plant, the separation of the sterile and fertile segments being very nearly at the surface of the ground, and not unfrequently even below the surface. The sterile segment, with its petiole, is not far from one-half the length of the fertile segment; though, as it is always somewhat inclined, or even spreading nearly horizontally, it does not stand half as high as the other, which is erect. The petiole of the sterile segment is nearly or quite as long as the segment itself: its lower portion is flesh-colored and terete; but the upper part is of a dull fuscous-brown, and impressed with a narrow channel, which extends upwards along the superior side of the rachis and all its branches.

The sterile frond is always deltoid, or, perhaps it would be more accurate to say, unequally five-sided. It consists of three primary divisions, which have longer or shorter special petioles according to the size of the plant. The two side divisions are but little smaller than the middle one: they are commonly opposite each other; though not unfrequently they are not exactly

opposite, but one is an eighth or a quarter of an inch below the other. These divisions, as is almost universally the case in a ternately compound leaf or frond, have their sides somewhat unequal, being broader or more developed on the lower side, so that their outline is unsymmetrically triangular-ovate. middle primary division is, of course, symmetrical, and broader than either of the side divisions. In the smallest and simplest fronds which I have seen, each of the three primary divisions consists of three little denticulate, rather obtuse ovate segments, not more than three lines long. From this, up to the ample decompound fronds of var. australe, or the delicately multisect var. dissectum, there are many degrees of complexity of incision, and of diversity in outline, of subdivisions and lobes. In var. lunarioides, the lobes or ultimate segments are mostly distinct and roundish-reniform, very much like those of B. Lunaria. In var. rutæfolium, only the lowest lobes are distinct; and they are very obliquely ovate, being cordate on the lower side, and rounded or truncate on the upper. The upper lobes are less and less distinct, and finally unite in an ovate, barely pointed terminal lobe. In var. australe the plant is usually of much larger size, and the sterile segment correspondingly more compound, being often fully four times pinnatisect. The lobes are obliquely ovate, the terminal one not long-pointed, and the margin more or less denticulated. Var. obliquum is characterized by having ovate-lanceolate long-pointed terminal lobes, the basal lobes being obliquely ovate. The margin is more or less denticulate; and, when the denticulations become very deep, the form passes into var. dissectum, reaching at last a condition in which all the divisions are laciniately cut up into very narrow and minute lobes and teeth.<sup>1</sup>

The hairs of the bud remain on the frond until it is fully developed, so that the plant is more or less hairy, though in old fronds this pubescence gradually disappears. The frond is very fleshy; perhaps more so than in any other species of the genus.

The fertile segment, unless dwarfed by some accident, considerably overtops the sterile, and varies, according to the size of the plant, from a little bipinnate raceme up to an ample panicle. Rarely two distinct fertile panicles are developed from one plant at the same time. The spores are thickly covered with very minute roundish protuberances.

The new fronds come up in New England and the Middle States in July, and the spores are matured in early autumn. During the winter the fertile panicle withers away; but the sterile segment remains until spring, or, not unfrequently, until

#### Botrychium ternatum.

A) EUROPÆUM.

a. campestris.

β. montana.

B) Australasiaticum.

a. vulgare.

Forma sub-bifoliata,

B. dentatum.

B) Australasiaticum (continued).

y. erosum.

8. millefolium.

C) AMERICANUM.

a. lunarioides.

β. obliguum.

y. dissectum.

<sup>&</sup>lt;sup>1</sup> The following is Dr. Milde's final arrangement of the forms of this species. His campestris and montana are simply larger and smaller plants, and his millefolium is nearly or quite identical with dissectum.

the new frond has made its appearance: so that a plant with two fronds, one of them the growth of the previous year, is not rarely seen.

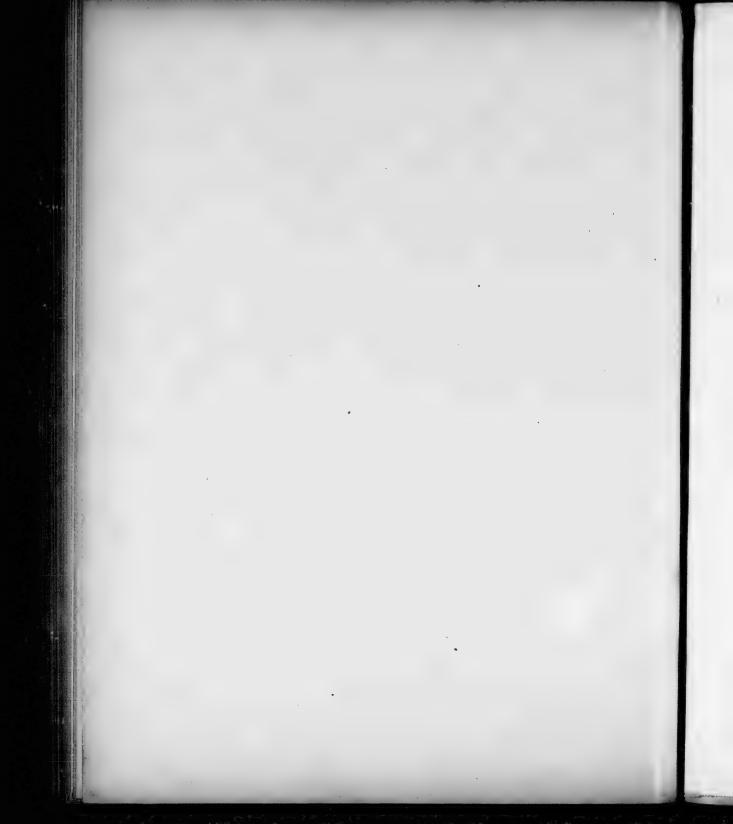
While the species, as a whole, extends round the north temperate zone, and is spread to the southward as far as Venezuela and Tasmania, some of the forms have a more or less restricted range. Var. lunarioides, as here considered, has been found only in South Carolina and the Gulf States; var. rutæfolium, though the only European form, occurs in America only in Newfoundland, New Brunswick, and the neighboring region; var. australe is found from Japan to Tasmania, in the Sandwich Islands, in Central America, Venezuela, New Granada, and Mexico, and thence through California to Unalaska, and again, in a somewhat reduced form, in Wyoming, the Middle States, and New England, where it passes by imperceptible and undefinable changes into var. obliquum. This transitional form, which we may call sub-variety intermedium, is the typical B. lunarioides of Gray's Manual. Dr. Milde's figure of B. rutæfolium, var. robustum (Nov. Acta. Acad. Nat. Cur., xxvi., ii., t. 55, fig. 9), from Unalaska, well represents it. Var. obliquum is common from Canada to the Gulf of Mexico, and extends, according to Milde, to Hudson's Bay and to Mexico. Var. dissectum is less common, but occurs from Canada to Florida, and is apparently identical with a plant in New Zealand.

The colored plate represents at the right a plant of var. *lunarioides* from Burke County, Georgia; in the middle is var. *obliquum*, from Medford, Massachusetts; and at the left is var. *dissectum*, from Maine. Of

the enlarged segments, the uppermost is var. *lunarioides*, the middle one var. *dissectum*, and the lowest var. *obliquum*. At the left are shown a group of sporangia enlarged, a highly magnified spore, and a bud both whole and in section. More finely divided plants of var. *dissectum* are not very uncommon.

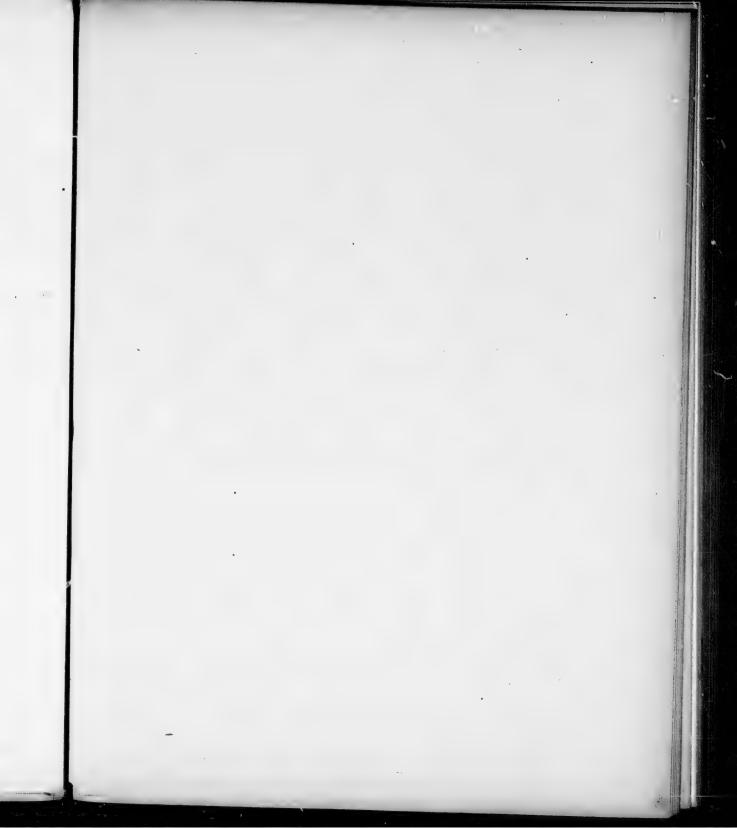
In the uncolored plate, the largest plant, behind the other two, is var. australe, from Plumas County, California, collected by Mrs. Austin; the middle plant is also var. australe, from Lewis County, New York (Mrs. Barnes); and the plant in front of the others is sub-var. intermedium, from Shelbourne, in New Hampshire. The larger detached segment is from another very large Californian plant, and the smaller one is from a second plant from Lewis County, New York.

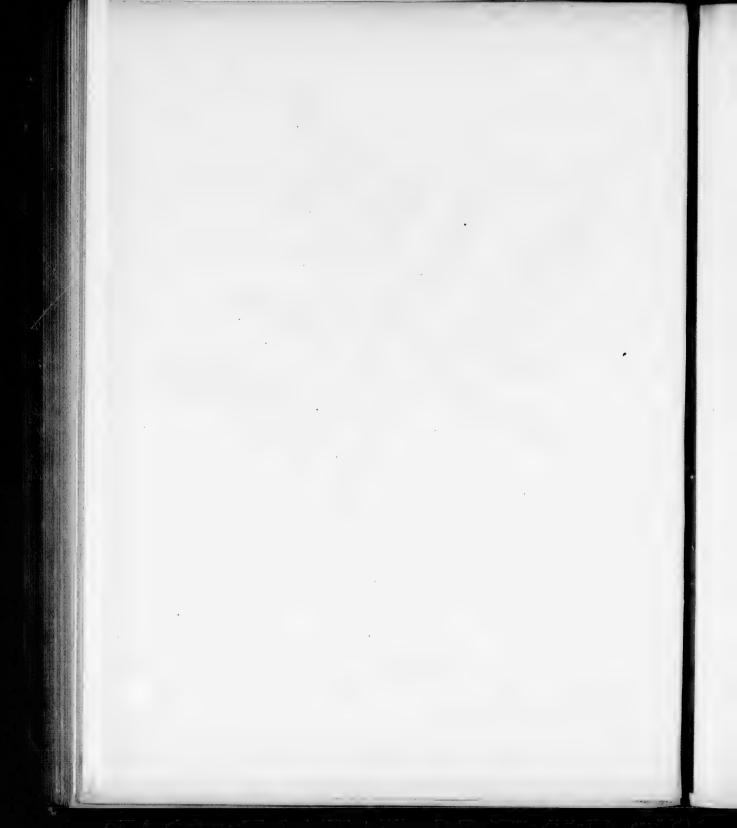
I have to express my thanks to Mr. Davenport for having selected most of these specimens, and for the great pains he has taken in assisting Mr. Emerton to arrange them for drawing.











## PLATE XXI.

# PHEGOPTERIS DRYOPTERIS, Fée.

## Oak-Fern.

Phegopteris Dryopteris:—Root-stock slender, cord-like, widely creeping; stalks scattered, slender, chaffy near the base, six to twelve inches high; fronds thinly herbaceous, smooth, deltoid, four to ten inches wide and long, ternate; primary divisions stalked and widely divergent, pinnate with usually opposite linear-oblong pinnæ, which are pinnately lobed or divided; lobes oblong, obtuse, slightly curved, entire or crenated, in very large fronds those of the middle division again pinnatifid; veins pinnately branched; sori rather small, seated in the back of the veinlets near the margin of the lobes.

Phegopteris Dryopteris, Fée, Genera Filicum, p. 243. — MEFTENIUS, Fil. Hort. Lips., p. 83; Phegopteris, p. 9. — EATON, in Gray's Manual, ed. v., p. 663. — MILDE, Fil. Eur. et Atl., p. 98.

Polypodium Dryopteris, Linnæus, Sp. Pl., p. 1555. — Swartz, Syn. Fil., p. 41. — Schkuhr, Krypt. Gew., p. 19, t. 25. — Torrey, Fl. New York, ii., p. 485. — Ruprecht, Dist. Crypt. Imp. Ross., p. 52. — Gray, Manual, ed. 1, p. 623, etc. — Hooker, British Ferns, t. 4; Sp. Fil., iv., p. 250. — Hooker & Baker, Syn. Fil., p. 309 (excl. var. Robertianum).

Nephrodium Dryopteris, MICHAUX, Fl. Bor. Am., ii., p. 270. Polystichum Dryopteris, Roth, Fl. Germ., iii., p. 30.

Polypodium calcareum, Pursh, Fl. Am. Sept., ii. p. 659 (not of Smith and Wilidenow).

HAB.—Open, rocky woods, not rare in Canada and the Northern United States, and extending to the mountains of Colorado, to Oregon, Unalaska, Labrador, and perhaps Greenland. It is found also throughout Northern Europe and Asia, from the British Isles to Kamtschatka, the southern limits being the Pyrenees and Northern Italy in Europe, and Tibet and Cashmere in Asia.

Description.—The oak-fern has a cord-like creeping root-stock, scarcely a line in diameter, but often a foot or more in length. It creeps several inches in advance of the growing fronds, the newer portion bearing a few thin ovate chaffy scales, and producing rudimentary stalks which grow up and bear fronds the coming year. The stalks are continuous with the root-stock, as in the Aspidia, and not articulated with it as they are in Polypodium. This is the best technical distinction between Phegopteris and Polypodium: the former being, as Mr. John Smith has termed it, desmobryoid; and the latter, eremobryoid.

The stalk is erect, very slender, greenish in the living plant, but stramineous in the dried specimen. The lowest portion is commonly somewhat flexuous, dark brown, and clothed with a few thin ovate scales like those of the root-stock.

The frond is thin-membranaceous, perfectly smooth, and of a clear leaf-green. It is broadly triangular in shape, and measures from four to eight or ten inches in breadth, and nearly as much in length. It is divided into three spreading parts, which

<sup>1</sup> See the explanation on p. 116, ante.

have distinct stalks from half an inch to an inch and a half long. The stalks of the side divisions join that of the middle division by a slight articulation. The middle division is considerably wider than the others, broadly and symmetrically triangular in shape, and is composed of several pairs of opposite sessile bipinnatifid pinnæ, the lowest of which is the largest, though much smaller than the stalked primary divisions below it. The two lateral primary divisions are also broadly triangular, but are not symmetrical, as the lower side of each is much more developed than the upper. The pinnæ of these are usually opposite, though not invariably so, and are once pinnatifid. The first pinna on the lower side of a lateral primary division is commonly equal in size and similar in cutting to the second pinna of the middle primary division. The lobes of all the pinnæ are oblong, obtuse, slightly curved upwards, and vary from entire to crenate or toothed, according to their size. Every lobe has a midvein, from which the veinlets proceed on either side. The veinlets are either simple or forked, and bear the small roundish naked fruit-dots near the margin of the lobes.

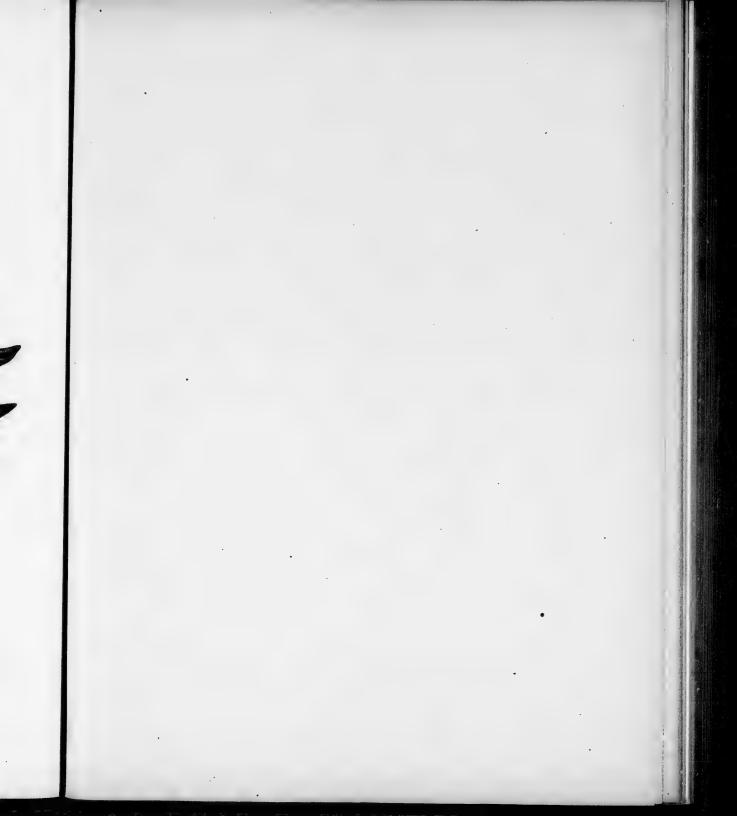
The sporangia are smooth; and the spores, which are beanshaped, are furnished with scattered warty prominences.

Closely allied to this species is the *Phegopteris calcarea* of Fée. It is more rigid in habit, has proportionately smaller lower pinnæ of the primary lateral divisions, and is everywhere dotted with minute sessile glands. It is found in Europe and Asia; and, though it has frequently been attributed to America also, I have never been so fortunate as to see an American specimen, and am persuaded that none has ever been discovered.

Plate XXI. — Phegopteris Dryopteris. The specimen represented was collected near Brattleborough, Vermont, by my venerable and excellent friend, Mr. Charles C. Frost, in 1858. It departs a little from the common type in having the lowest pinnæ of the side divisions not exactly opposite, but the superior one a little lower down on the partial rachis than the inferior one.









## PLATE XXII. - Fig. 1.

# ASPIDIUM LONCHITIS, SWARTZ.

# Holly-Fern.

Aspidim Lonchitis:—Root-stock stout, ascending, very chaffy; stalks short, clustered, bearing large ferruginous scales intermixed with finer chaff; fronds evergreen, sub-coriaceous, six to eighteen inches long, one to two and a half inches wide, linear-lanceolate, narrowed moderately at the base, acute or acuminate at the apex, pinnate; pinnæ very numerous, crowded, broadly lanceolate, falcate, spinulose-serrate, acute; the lower ones symmetrically triangular; the upper ones strongly auricled on the upper side, and cuneate on the lower; sori in a double row on the pinnæ and the auricle; indusium orbicular, attached by the centre.

Aspidium Loachitis, Swartz, in Schraders Journal, 1800, ii., p. 30.—
Sprengel, Anleitung, p. 125 (Engl. version, p. 138).—Swartz,
Syn. Fil., p. 43.—Schkuhr, Krypt. Gew., p. 29, t. xxix.—Willdenow, Sp. Pl., v., p. 224.—Mettenius, Fil. Hort. Lips., p. 88;
Phegopt. & Aspid., p. 41.—Gray, Manual, ed. ii., etc.—Hooker,
Brit. Ferns, t. ix.; Sp. Fil., iv., p. 8.—Hooker & Baker, Syn.
Fil., p. 250.—Milde, Fil. Eur. et Atlant., p. 104.

Polypodium Lonchitis, LINNÆUS, Sp. Pl., p. 1548.

Polystichum Lonchitis, Roth, "Tent. Fl. Germ., iii., p. 71."— Schott, Gen. Fil. (with a plate giving details of structure).— Press., Tent.

Pterid., p. 82. — Fée, Gen. Fil., p. 278. — Gray, Manual, ed. i.; p. 632. — Moore, Nat. Print. Brit. Ferns, t. ix. — Ruprecht, Dist. Crypt. Vasc. Imp. Ross., p. 38. — W. D. Whitney, in Foster & Whitney's Rep. on Geol. of L. Superior, part ii., p. 380.

HAB.—Rocky places, from the vicinity of Georgian Bay, Lake Huron, Canada, Professor Hincks, Mrs. Rov, Mr. Watt, to the southern shore of Lake Superior, Professor Whitney, etc., and westward to the Cascade Mountains of British Columbia, Dr. Lyall. Southward it occurs along the mountains as far as Utah, having been found in the Wahsatch Mountains by Mr. Watson, and near Spring Lake by Dr. Parry. Northward it extends to Unalaska and Greenland; and in the Old World it occurs in alpine and sub-alpine regions from the British Islands to the Caucasus, and from Spain to Lapland and Siberia. Dr. Milde gives Labrador also, but I know not on whose authority.

Description. — The holly-fern has a thick and almost woody root-stock, closely covered with the imbricating bases of former stalks. The newer portion is very chaffy, with ample ovate rusty-brown scales. The fronds stand in a crown at the top of the root-stock, and are nearly sessile, or at most have stalks only four or five inches long. These stalks bear copious large chaffy scales, mixed in with much smaller and narrower scales: the latter are seen in greater or less abundance along the rachis also. The fronds vary in length from a few inches to two and a half feet, and in width from less than an inch to two inches and a half. In outline they are narrowly lanceolate, the greatest width being above the middle of the frond, so that they are gradually narrowed downwards for more than half their length.

The apex is acute or shortly acuminate. The pinnæ are closely placed, and very numerous, a frond of average size having as many as fifty on each side of the rachis. The lower pinnæ are triangular, having the upper and lower sides nearly equal, and slightly auricled. Higher up the frond, as the pinnæ become longer, the inferior auricle disappears, and presently the lower side of the pinnæ is narrowed at the base, while the auricle on the upper side is more developed, and at the same time the pinnæ are strongly curved upwards. The edges of the pinnæ are serrate, having large spinulose-pointed teeth, with much smaller pointless teeth interposed between them. The veins are free, and proceed from a midvein. The fronds are rather rigid, subcoriaceous in texture, and evergreen. The upper surface is smooth, but the under surface is more or less chaffy. The fruit-dots, which are confined to the upper portion of the frond, are usually arranged in a single row each side of the midvein, and about half way between it and the margin: they also occur on the auricles in two similar rows.

The indusium is orbicular and nearly entire, and attached by the centre to a short stem which rises from the middle of the fruit-dot. As the sporangia mature, the indusium contracts a little at the margin, and becomes somewhat funnel-shaped. The spores are ovoid-bean-shaped, and have a minutely muriculate surface.

The holly-fern is singularly free from variation; the only differences noticed being of size, and of coarser or finer serration. It belongs to the same group of species as A. acrosti-

choides of eastern North America, and A. munitum of the western side of the continent. The first has a decidedly stalked, broader frond, the lower pinnæ scarcely reduced in size, and the fertile ones much contracted. Aspidium munitum, to be figured presently, is usually a much larger plant than that now under consideration, has a well-developed stalk, and usually clongated pinnæ, the lower ones scarcely reduced.

The genus Aspidium, as understood by Mettenius, contains not less than three hundred and fifty species, by far the greater part with reniform indusia. Hooker and Baker separate this portion under the name of Nephrodium, keeping Aspidium for the species with orbicular indusia. Polystichum, of Roth, is an older name than Aspidium, and would seem to have been originally intended to have nearly the same application. Schott, and, after him, Presl and Moore, have limited the use of the name to the species with orbicular indusium and free veins; while Koch has chosen to give the name to the species with reniform indusia, and to call Schott's Polystichum by Swartz's na.ne of Aspidium. But the signification of the word Polystichum (many, rows) is inapplicable to most Aspidia; and perhaps this is the best reason for adopting the name proposed by Swartz.

Plate XXII., Fig. 1. — *Aspidium Lonchitis*, from Owen Sound, Canada, collected by Mrs. William Roy. The smaller figure to the right of the stalk shows a fruiting pinna.

### PLATE XXII. - FIG. 2.

# WOODWARDIA ANGUSTIFOLIA, SMITH.

# Netted Chain-Fern.

Woodwardia angustifolia:—Root-stock rather slender, creeping, elongated; stalks scattered, six to twelve inches high, chaffy only at the base; fronds ovate-oblong, membranaceous, smooth, pinnatifid; the sterile ones six to twelve inches long, two-thirds as broad, having ample lanceolate finely serrulate divisions united at the base by a broad wing, the veinlets forming several rows of oblong-hexagonal areoles; fertile fronds taller, having almost disconnected narrowly linear segments, the areoles in a single row each side the midvein, each areole containing an elongated sorus covered by an arched indusium attached by its outer margin to the fruiting veinlet.

Woodwardia angustifolia, Smith, in Mém. Acad. Turin, v., p. 411. — Torrev, Fl. N.Y., ii., p. 490. — Gray, Manual, ed. i., p. 625; ed. ii., p. 593, t. x., figs. 1, 2, 3. — Beck, Botany, ed. ii., p. 462. — Mettenius, Fil. Hort. Lips., p. 66, t. vi., figs. 6, 7. — Eaton, in Chapman's Flora, p. 591. — Wood, Botanist and Florist, p. 371.

Woodwardia Floridana, Schkuhr, Krypt. Gew., p. 103, t. 111.

Woodwardia onocleoides, Willdenow, Sp. Pl., v., p. 416. — Pursh, Fl. Am. Sept., ii., p. 669. — Bigelow, Fl. Bost., ed. iii., p. 423. — Wood, Class-Book, p. 632.

Woodwardia arcolata, Moore, Ind. Fil., p. xlv. — Hooker, Sp. Fil., iii., p. 70; Garden Ferns, t. lxi. — Lowe, Ferns, t. xlvi. — Hooker & Baker, Syn. Fil., p. 189.

Acrostichum arcolatum, Linnæus, Sp. Pl., p. 1526.

Lorinseria arcolata, Presl, Epim. Bot., p. 72. — Fée, Gen. Fil., p. 208, t. 17 B. — J. Smith, Ferns, Brit. and Foreign, p. 207.

Onoclea nodulosa, Michaux, Fl. Bor. Am., ii., p. 272.

Osmunda Caroliniana, WALTER, "Fl. Carol., p. 257."

Acrostichum fronde pinnata, foliolis alternis linearibus apice serratis, Gronovius, Fl. Virg., p. 124; ed. ii., p. 165.

HAB.—Wet swampy woods, not very common, but plentiful in certain localities, from Massachusetts to Florida and Louisiana, apparently never very far from the coast. It occurs near Hingham and Amherst in Massachusetts; in East Haven, Orange, and Stratford, in Connecticut; at Wading River, and near Hempstead, on Long Island; and is by no means rare in the lower portions of New Jersey.

Description.—The root-stock is several inches or even a foot long, often branched, round, and rather less than a quarter of an inch thick. It is of a very dark brown, and bears blackish fibrous roots along its whole length. The newest portion has a few very thin appressed scales. A short distance from the apex a few (2-4) stalks rise, usually from alternate sides; and still nearer the end are one or two spur-like undeveloped stalks. The bases of the old stalks remain a year or two before they finally decay. The fertile and the sterile fronds are unlike; and it was this heteromorphism, combined with some differences in the venation, that induced Presl, and after him Fée and John

Smith, to consider this fern the type of a genus distinct from Woodwardia.

The sterile fronds, which are far the most abundant, are usually nine or ten inches long, and rest on a stalk of about the same length. The stalk is naked, except for a few very thin scales at the base. It is dark-brown or blackish at the base, becoming paler higher up, and passing into the green color of the rachis as it nears the frond. In section it is very convex on the back and sides, and slightly convex on the face. Where the two convexities meet there is on each side a slightlyraised line, which higher up becomes more prominent, and passes into the border or wing of the rachis. There is a single central fibro-vascular bundle,1 convex on the back, and either flattened or slightly hollowed on the face. The frond itself is oblong-ovate in outline, and consists of a terminal segment, variable in size, and more or less sinuately lobed, and from four to twelve oblong pointed lobes on each side. These lobes are separated by broad open or rounded sinuses or bays, and are connected at their bases by a wing which runs along either side of the rachis or midrib, from just below the base of the frond, where it is very narrow, up to the terminal lobe, widening upwards, and near the apex often fully half an inch The lobes are from one to four inches long, and broad. from half an inch to an inch wide. They are more or less undulate, and are finely serrated. In texture they are softly

<sup>&</sup>lt;sup>1</sup> Presl says there are three in the stalk of the sterile frond, and one in that of the fertile. I find but one in either stalk.

membranaceous and perfectly smooth, and in color bright-green above, and somewhat paler beneath.

The veins and veinlets are slightly impressed, and are very evident; and, as they are finely reticulated, they give the frond an areolated appearance. Along each side of the midrib and midveins there is a longitudinal row of narrow areoles; outside of these there are three or four irregular rows of obliquely hexagonal areoles; and at the very edge there is a series of short free veinlets, one extending to each tooth of the serration.

The fertile fronds are considerably taller than the sterile, and have a much longer and darker-colored stalk. They are about the same size as the others, and have as many divisions; but these are narrowly oblong-linear, being only one and a half to two lines wide. The wing of the midrib is reduced to a scarcely perceptible border, which, however, widens out a little to meet the base of each segment. The margin of the segments is obscurely crenulate, and usually somewhat recurved. The areoles are reduced to the paracostal series (one row each side the midvein) and a few free marginal veinlets. These paracostal areoles are three or four lines long, and each one is nearly covered by a rather heavy and rigid oblong vaulted brownish involucre, which is attached to the enclosing veinlet, and is free along the edge next the midvein. Under the involucre the sporangia grow; also from the enclosing veinlet. The sporangia are provided with the usual incomplete vertical elastic ring of the *Polypodiacea*. The spores are ovoid-spherical or obscurely spheroid-tetrahedral, and appear to have a smooth surface.

The sterile fronds appear in May (in Connecticut), and the fertile fronds somewhat later; so that the fruit is not ripe until autumn. The fronds wither soon afterwards, and presently disappear.

I have preferred the name assigned to this fern by Sir James Edward Smith when he proposed the genus, although the specific name given by Linnæus is older, and fully as appropriate.

The genus was named in honor of Thomas Jenkinson Woodward, LL.B., a fellow of the Linnæan Society. Smith's account of the genus and the species known to him reads thus:—

- "Woodwardia: Fructificatio in punctis oblongis, distinctis, serialibus, costæ adjacentibus. Involucra superficiaria, fornicata, costam versus dehiscentia."
- "I. W. angustifolia: fronde pinnata; pinnis linearibus acutis integerrimis. Habitat in Pennsylvania. Ex amicissimo viro D. Georgio Staunton Baronetto habui.
  - "2. W. Japonica. (Blechnum Japonicum, Thunb.)
  - "3. W. Virginica. (Blechnum Virginicum, Linn.)
  - '4. W. radicans (Blechnum radicans, Linn.)"

It is very probable that Smith received only fertile fronds from his friend Staunton; and, as these had very narrow pinnæ, he gave the name angustifolia to the species, being not aware that the Acrostichum areolatum of Linnæus was the same thing.

Woodwardia Harlandii, of Hooker, from Hong-Kong, and

perhaps *W. orientalis*, of Swartz, are the only good species that have been added to the genus; for, although many new *names* have been proposed, it has happened in all other cases that they were but synonymes for the species already known.

Plate XXII., Fig. 2.— Woodwardia angustifolia, from a plant collected by my honored father, the late General Amos B. Eaton, near Stratford, Connecticut, in 1856. The details require no explanation.





## PLATE XXIII. - Fig. 1.

## PHEGOPTERIS ALPESTRIS, METTENIUS.

## Alpine Beech-Fern.

PHEGOPTERIS ALPESTRIS: — Root-stock short and thick, erect or oblique; stalks sub-terminal, four to ten inches long, bearing a few brown spreading scales near the base; fron is one to two feet long, oblong-lanceolate, membranaceous, smooth, pinnate with delicately bi-pinnatifid deltoid-lanceolate pinnæ, the lower ones distant, and decreasing moderately; pinnules ovate-oblong or oblong-lanceolate, doubly incised and toothed; sori small, rounded, naked, usually copious on all or all but the lowest pinnæ.

Phegopteris alpestris, METTENIUS, Fil. Hort. Lips., p. 83; Phegopteris, p. 10.

Polypodium alpestre, Hoppe, "in Spreng. Syst. Veg., iv., par. ii., p. 320."—
Koch, Syn. Fl. Germ., "ed. 2, p. 974;" ed. 3, p. 731.— Moore,
Nat. Pr. Brit. Ferns, t. vii.— Hooker & Arnott, Brit. Fl., ed. 7,
p. 582.— Hooker, Brit. Ferns, t. vi.; Sp. Fil., iv., p. 251.—
Hooker & Baker, Syn. Fil., p. 311.

Aspidium alpestre, Swartz, Syn. Fil., p. 421. — Schkuhr, Krypt. Gew., p. 58, t. 60.

Asplenium alpestre, METTENIUS, Asplenium, p. 198, t. vi., figs. 1-6.

Pseudathyrium alpestre, Newman, "Phytologist, iv., p. 370;" Hist. Brit. Ferns, ed. iii., p. 200.

Athyrium alpostre, "Nylander;" Milde, Fil. Eu. & Atl., p. 53.

Polypodium rhæticum, Linnæus, Sp. Pl., p. 1552, fide Schkuhr, l. c.; but Moore thinks the plant not the same.

Aspidium rhæticum, Swartz, Syn. Fil., p. 59. — Willdenow, Sp. Pl., v., p. 280.

Hab. — Among rocks at high elevations; on Lassen's Peak, Mount Shasta, Pyramid Peak, Mount Rose, and other high points in the Sierra of California, Brewer, Lemmon, Muir; Cascade Mountains of British Columbia, Lyall. In the Alps and the mountains of Northern Europe; also in the Caucasus, and in Asia Minor.

Description.—The root-stock is rather short, but branching, and seems to form great entangled masses. The fronds stand in a crown or circle, rising from the end of the root-stock, which is made thick and heavy with the chaffy bases of former stalks. Mr. Lemmon writes thus: "It grows in a limited locality, so far as I know, near the summit of Mount Rose, near Webber Lake, and say at an elevation of 7,000 feet; lat. 39½° N. Fronds collected into a large mass four feet across, short at the circumference, in the centre three feet high; most of them fertile, and densely so, as in the specimen sent."

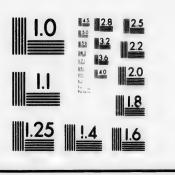
The stalks are usually but a few (four to six) inches long, and in the dried specimens of a brownish straw-color, becoming nearly black at the base. They bear a few large ferruginous chaffy scales, and are deeply channelled and furrowed. The fibro-vascular system of the stalk is altered by contraction in drying, but apparently agrees with Dr. Milde's description of Athyrium: "There are two oblong peripheric bundles in the

base of the stalk, which, at the base of the lamina, are united into one of a horse-shoe shape by an arc parallel to the back of the stalk." In the middle of a stalk from one of the California specimens I find two systems of ducts, one on each side of the stalk, and the two united by a curved and contorted border of firm blackish tissue (sclerenchyma).

The fronds are from one to two feet long, and from three to six inches wide. In general shape they are oblong-lanceolate, acuminate, and slightly narrowed at the base. The texture is softly membranaceous, and both surfaces are smooth. The primary pinnæ are numerous, the lower ones gradually farther apart: their shape is lanceolate from a broad base. They are usually twice pinnatifid, the pinnules being connected by a very narrow foliaceous border along the midribs. The ultimate segments are sharply toothed. The fruit-dots are very abundant, and usually are found on all the pinnæ. They are placed on the back of the free veinlets, and are apparently devoid of indusium; though Dr. Mettenius has discovered on young fronds an exceedingly delicate and fugitive indusium, resembling in some degree that of Asplenium & Athyrium. Accordingly, in his later work, he referred the species to the genus Asplenium, placing it next to A. Filix-famina. Milde, in his work on the ferns of Europe and Atlantis, sought to re-establish Athyrium as a genus, and placed this fern in it, saying "sori . . . rotundi, primum breviter oblongi indusio fugaci minutissimo ciliato instructi." The spores are ovoid, and apparently covered with anastomosing raised lines. Those I have examined are fuscous-brown, but Milde says "sub-nigræ verrucosæ."

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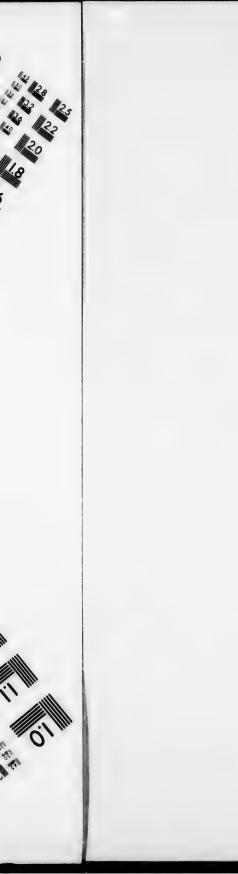
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There is a European var. *flexilis*, with very narrow, nearly sessile fronds, and the pinnæ often deflexed, which has not been observed in America.

Undoubtedly the greatest resemblance of this fern is to the lady-fern, Asplenium Filix-famina; but that species has a very well-developed indusium, while the minute objects delineated by Mettenius scarcely deserve the name.

The stalks are clearly continuous with the root-stock; and for this reason the plant is plainly not a *Polypodium*, whatever else it may finally be determined to be.

Plate XXIII., Fig. 2. — Phegopteris alpestris: a specimen collected in the California Sierra by Professor Brewer in 1862.

### PLATE XXIII. - Fig. 2.

# ASPIDIUM FRAGRANS, SWARTZ.

## Fragrant Wood-Fern.

Aspidium fragrans:—Root-stock short and stout, very chaffy, with ample bright-brown glossy scales, which also abound on the short clustered stalks, and extend, diminishing in size, nearly to the top of the frond; fronds rigid-membranaceous, glandular, aromatic, four to ten inches long, six to twenty-four lines wide, lanceolate, acuminate, narrowed from the middle to the base, bipinnate; pinnæ numerous, oblong-lanceolate; pinnules many, one to two lines long, oblong, obtuse, adnate by a decurrent base, pinnately incised with very minute crenated teeth, or in smaller fronds nearly entire, the back nearly hidden by the large thin imbricating indusia, which are orbicular with a narrow sinus, and more or less toothed and glandular around the margin.

Aspidium fragrans, Swartz, Syn. Fil., p. 51. — WILLDENOW, Sp. Pl., v., p. 253. — Hooker, in "Parry's 2d Voy., App., p. 410;" Fl. Bor. Am., p. 410. — Ruprecht, Distr. Crypt. Vasc. Imp. Ross., p. 35. — Mettenius, Aspid., p. 56: — Grav, Manual, ed. 2, p. 598. — Milde, Fil. Eur. et Atlant., p. 117.

Polypodium fragrans, LINNÆUS, Sp. Pl., p. 1550.

Polystichum fragrans, Ledebour, "Fl. Ross., iv., p. 514." — MAXIMOWICZ, Prim. Fl. Amur., p. 339.

Dryopteris fragrans, Schott, Gen. Fil., Observ. sub Polysticho.

Nephrodium fragrans, Richardson, "App. to Frankl. Journ., p. 753."—

Hooker & Greville, Ic. Fil., t. lxx.—Hooker, Sp. Fil., iv.,
p. 122.—Hooker & Baker, Syn. Fil., p. 275.

Dryopteris rubum idæum spirans, Ammann, "Ruth., p. 251."

HAB.—In crevices of shaded cliffs, and on mossy rocks, especially near cascades and rivulets, from Northern New England to Wisconsin, and northward to Arctic America. Also in the Caucasus, and in Siberia, Mantchooria, and Kamtschatka. Special American localities are Mount Kineo, Maine, A. H. and C. E. SMITH; at Berlin Falls, the "Alpine Cascade," and the "Gulch," all near the White Mountains, H. WILLEY; Mount Mansfield, Vermont, C. G. PRINGLE; Lake Avalanche, Adirondack Mountains, New York, C. H. PECK; Falls of St. Croix, Wisconsin, C. C. PARRY, and on the Penokee Iron Range, in the same State, LAPHAM; Saguenay River, Canada, D. A. WATT. It is apparently more common farther north: Sitka, Iliuliuk, Unalaska, Arakamtchetchene, Kotzebue Bay, Igloolik, Rittenbenk in Greenland, and several other places, are recorded as stations for it.

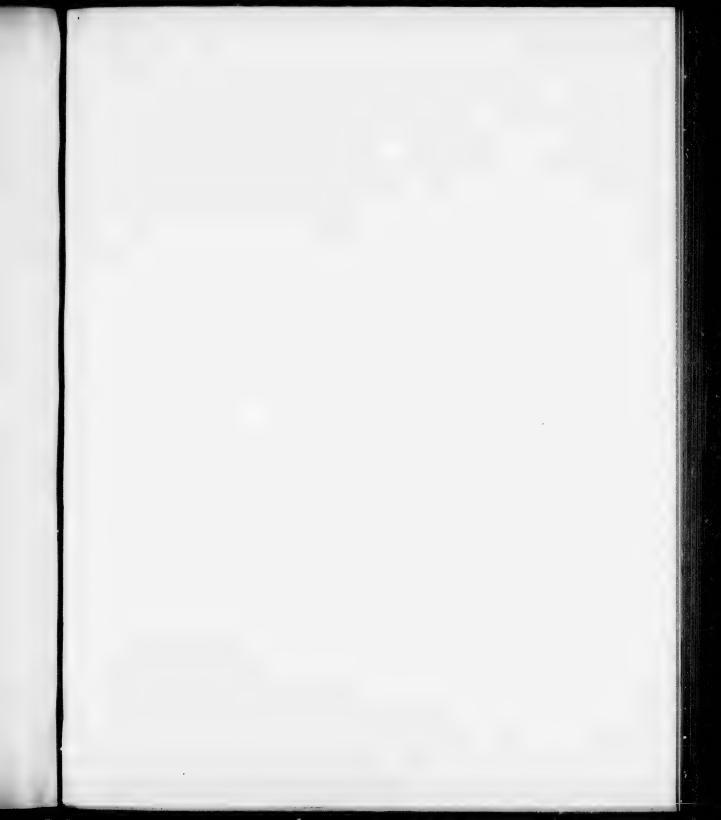
Description. — The root-stock is rather stout, ascending or erect; and its apparent thickness is much increased by the persistent bases of stalks, which also give it a dense covering of broad bright-brown chaffy scales. The fronds, frequently to the number of six or eight, besides old and shrivelled ones, stand in a crown at the upper end of the root-stocks, resting on stalks from one to four inches long, which are usually very chaffy, the chaff continued along the rachis and midribs, though composed of smaller scales than those lower down. The fronds are from three or four to ten inches in length; and the greatest breadth, just above the middle, is from one-fifth to one-sixth of the length.

The outline is exactly lanceolate, as the apex is acute, and the lower part gradually tapering to a somewhat narrowed base. The fronds are delicately, but densely, bipinnate. In a frond nine inches long there are about thirty primary pinnæ on each side, and in one of the middle pinnæ about ten oblong-ovate obtuse pinnately-incised pinnules on each side. The pinnules are from a line to two lines long, and are adnate to the secondary rachis by a more or less decurrent base. In large fronds the teeth of the pinnules are again crenately toothed; but in small specimens the pinnules themselves are entire, or but slightly toothed. Two sterile fronds collected by Professor M. W. Harrington, in Iliuliuk, Alaska, are broadly ovate-lanceolate in outline, and have acute primary pinnæ; and other specimens, some from Eastern Canada, collected by Mr. Watt, and some from Northern Wisconsin, collected by Mr. Lapham, are much slenderer and less scaly than usual. This is the var. \( \beta \) of Hooker. Usually the fronds are rather rigid, full-green above, a little paler beneath, and both surfaces, together with the rachis, especially the canal along the upper side of the rachis, are dotted with very minute pellucid pale amber-colored glands. The fronds commonly fruit very fully, even the lowest pinna bearing sporangia. The indusia are very large, thin, orbicular, with a narrow sinus, more or less ragged or toothed and gland-bearing at the margin, and are so dense as to overlap each other, and nearly conceal the back of the pinnules. The spores are ovoid, and have a minutely verrucose or warty surface.

The pleasant odor of the plant remains many years in the

herbarium. The early writers compare the fragrance to that of raspberries, and Milde repeats the observation. Hooker and Greville thought it "not unlike that of the common primrose." Maximowicz states that the odor is sometimes lacking. Milde quotes Redowsky as saying that the Yakoots of Siberia use the plant in place of tea; and, having tried the experiment myself, I can testify to the not unpleasant and very fragrant astringency of the infusion.

The illustration is taken from a plant collected by Mr. D. A. Watt on the Saguenay River, in Canada.









#### PLATE XXIV. - Fig. 1.

## TRICHOMANES RADICANS, SWARTZ.

#### Alabama Bristle-Fern.

TRICHOMANES RADICANS: — Root-stock slender, widely creeping; fronds very delicate, pellucid, smooth, borne on short winged stalks, lanceolate or ovate-lanceolate, four to eight inches high, six to eighteen lines broad (larger in foreign specimens), bipinnatifid; rachis winged throughout; pinnæ triangular-ovate, obtuse, the upper side of the base closely parallel to the rachis, the lower cuneate; divisions toothed, or divided into linear lobes; involucres usually terminal on the lowest superior lobe of a division, or on several lobes, tubular funnel-form, margined, truncate at the mouth, and slightly two-lipped; columella bristle-like, rising from the bottom of the involucre, more or less exserted, the included portion bearing the sporangia.

Trichomanes radicans, SWARTZ, Fl. Ind. Occ., p. 1736; Syn. Fil., p. 143. — WILLDENOW, Sp. Pl., v., p. 513. — HOOKER, Sp. Fil., i., p. 125. — GRAY, in Am. Jour. Sc. and Arts, May, 1853, p. 325. — EATON, in Chapman's Flora, p. 597. — HOOKER & BAKER, Syn. Fil., p. 81. — Fee, Hist. Foug. et Lycop. d. Antilles, p. 109. — WILLIAMSON, Ferns of Kentucky, p. 123, t. xlviii.

Trichomanes scandens, HEDWIG, Fil. Gen. et Sp. (with a plate), not of

Trichomanes Boschianum, Sturm, in litt. — VAN DEN BOSCH, Hymenoph. Syn. Suppl., p. 160.

HAB.—On shaded and overhanging sandstone cliffs, constantly moistened by percolation or by spray. First discovered by Hon. T. M. Peters in Winston (formerly Hancock) County, Alabama, in July, 1852, and later in the same year found by Mr. J. F. Beaumont in Franklin County, and by both gentlemen in Lawrence County. Afterwards it was detected in the Cumberland Mountains of Eastern Tennessee by Rev. Dr. Curtis. It was discovered in Carter County, Kentucky, in 1872, by Dr. H. Hill, as stated by Mr. Williamson. In 1873 Professor John Hussey also found it in Carter County, and in Edmonson and Barren Counties. It has since been collected in Laurel and Rockcastle Counties by Mrs. Yandell, Miss Rule, and Dr. Crosier; and will doubtless be found in other places in the States of Alabama, Tennessee, and Kentucky.

DESCRIPTION. - The Alabama bristle-fern, as it may be called to distinguish it from the forms of Trichomanes radicans growing in other countries, is by far the most delicate of the ferns of the United States. The root-stock is blackish and fibrillose, especially the newer portions, with very slender and minute dark blackish-brown chaffy hairs. It is creeping, and not unfrequently a foot in length, while the thickness is less than a line. The fronds are scattered along the whole length of the root-stock: they are from three to seven inches long, and less, sometimes much less, than two inches wide. They rest on short stalks, which are winged from the very base, the wing continuing along the rachis to the top of the frond. The fronds are lanceolate or ovate-lanceolate in shape, and are bipinnatifid, or even tripinnatifid. The pinnæ are triangular-ovate or rhomboidal, the lower ones a little shorter and broader than those in the middle. They are divided into narrow oblong obtuse lobes, or into segments composed of several such lobes. The midvein is pinnately branched, and from the veins single veinlets extend through the middle of every lobe. The frond is smooth throughout, and, excepting the veins, is composed of a single layer of slightly elongated hexagonal cells, the middle of each cell vacant and transparent, the chlorophyl consisting of minute grains lining the cell-wall. The fruit, when it is present, is formed at the ends of the lower lobes of the divisions or segments of the pinnæ, and consists of little funnel-shaped cups, narrowly wing-margined, and having an obscurely two-lipped orifice. From the bottom of this cup there rises a slender dark-colored bristle-like receptacle or columella, on the sides of which, inside the cup, are borne the top-shaped sporangia. These have a nearly horizontal complete elastic ring. The spores are ovoid and obscurely papillose.

A careful description of the mode of growth of this most interesting fern was written by Professor John Hussey, and published by Mr. Williamson in his "Ferns of Kentucky." Another account, by the same close observer, was published in "The Independent" of Feb. 25, 1875:—

"I discovered it growing in more than a dozen localities under the Green River Country cliffs. It was found in every instance on the under side of an overhanging rock, generally considerably withdrawn from the light, never reached by the direct rays of the sun. It does best on a moist

<sup>&</sup>lt;sup>1</sup> See the elaborate monograph on the structure of Hymenophyllacea by Dr. Mettenius, wherein the various forms of cells and dispositions of chlorophyl are described and figured.

rock, where it is bedewed by spray from falling water, or where the clear water trickling from hidden springs keeps the fronds constantly moist, and where the fine drops hang trembling on the pendent fronds before falling. Each frond of this fern has an interesting history. From first to last, they live many years. The whole under surface of the rock is one matted mass of roots and stems, covered with innumerable translucent fronds, in all stages of growth and maturity. The young frond gradually expands, and slowly attains full size. In two or three years, perhaps, the fruit begins to develop on the edges of the fronds, at the tips of the veins. This fruit is clustered in a cup around a fine hair which comes from its centre. The hair, or bristle, continues to grow in length, and the fruit to develop at its base around it. As the bristle grows in length — sometimes it is found an inch long — the ripe fruit is shed, so that there remains about the same quantity of fruit always at the base of the hair. The whole life of the frond may be half a dozen years."

Our plant differs from the original plant of Swartz, from the West Indies, only in its somewhat smaller size; and, if not specifically identical with the Killarney bristle-fern, then *that* is to be called *T. speciosum* (Willdenow), and ours should keep the name of *T. radicans*. The name proposed by Sturm, and published with a long description by Van den Bosch, is wholly superfluous.

Plate XXIV., Fig. 1. — *Trichomanes radicans*: a plant with four fronds in various stages of development. The magnified parts sufficiently explain themselves.

#### PLATE XXIV. - Fig. 2.

## TRICHOMANES PETERSII, GRAY.

#### Peters's Bristle-Fern.

TRICHOMANES PETERSII:—A tiny plant, growing in broad patches: root-stocks threadlike; fronds two to six lines long, cuneate-obovate or oblong-lanceolate, entire or variously lobed, narrowed into a slender stalk as long as the frond, the younger ones often with a few forked blackish hairs along the margin; voins forked, pinnate from a midvein, a few unconnected veinlets also present, but no marginal vein; involucre solitary, terminal, funnel-form, the mouth expanding, and slightly two-lipped; columella scarcely exserted.

Trichomanes Petersii, Gray, in Am. Jour. Sci. and Arts, May, 1853, p. 326.

— Ноокев, Ic. Pl., х., t. 986. — Van den Bosch, Syn. Hymenophyllacearum, p. 15. — Елтон, in Chapman's Flora, p. 597. — Ноокев & Вакев, Syn. Fil., p. 74.

Microgonium Petersii, VAN DEN BOSCH, Hymenoph. Javan., p. 7.

Hab.—In the shade, on sand-rock kept moist by running water, near the Sipsey River in Winston County, Alabama: discovered by Hon. Thomas Minott Peters Jan. 8, 1853, and since gathered by the same naturalist in other neighboring places. The Florida station, mentioned in Chapman's Flora, needs confirmation, and is very possibly an error.

DESCRIPTION. - This is altogether the tiniest of all our ferns, and can be compared only with some closely-related species from tropical regions. The plant grows on the face of moist sand-rock in great patches, often three or four feet in extent, and always near running water. The little fronds are variable in shape, but in general are cuneate-obovate, with the margin wavy, and often somewhat lobed. The texture is finer and more opaque than that of T. radicans, the cells irregularly sub-quadrate, and the chlorophyl grains spherical and very distinct. There is usually a central vein, with several simple or more often forked veinlets on each side, and, beside them, a few free disconnected veinlets, the so-called venulæ spuriæ. Along the margin, on the younger fronds, are seen a few simple or usually widely-forking blackish hairs, which also occur on several foreign species, as T. punctatum, T. reptans, T. pusillum, etc. The solitary involucre terminates the midvein, and is sunken in the frond: it is funnel-shaped, with a somewhat flaring and slightly two-lipped mouth. The receptacle, or columella, is included, or rarely a little exserted.

The sporangia are like those of T. radicans.

Plate XXIV., Fig. 2. — *Trichomanes Petersii*: a group of fronds, the natural size, and one considerably enlarged, showing the involucre, venation, etc.

## PLATE XXIV. - Fig. 3.

## SCHIZÆA PUSILLA, PURSH.

## New-Jersey Schizæa.

SCHIZÆA PUSILLA: — Plant tufted; sterile fronds linear, flattened and tortuous, very slender, barely one-fourth of a line wide and scarcely an inch long; fertile ones almost as slender, but straighter, three to four inches high, bearing at the top the fertile appendage, consisting of about five pairs of close-placed oblong pinnæ, the lowest not more than two lines long, each bearing on one face a double row of sessile ovate sporangia having an apical radiated cap-like ring.

Schizæa pusilla, Pursh, Fl. Am., Sept., ii., p. 657. — Hooker & Greville, Ic. Fil., t. xlviii. — Presl, Suppl., p. 74. — Grav, Manual, ed. 1, p. 634; ed. 2, p. 600, t. 13. — Hooker & Baker, Syn. Fil., p. 428. Schizæa tortuosa, Muhlenberg, Catal., p. 102.

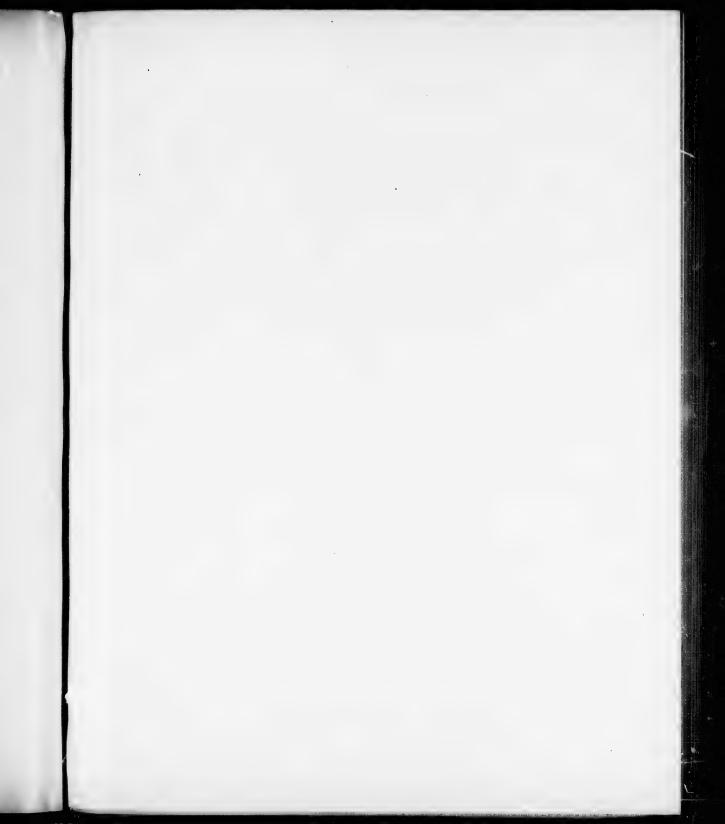
HAB.—Central and eastern counties of New Jersey, usually in the dryer parts of sphagnous swamps, among white cedars. First found about 1813, at Quaker Bridge, by Dr. Eddy. Near Tom's River, Dr. Torrey, August, 1832. Kettle Creek, Ocean County, Dr. Knieskern. Since collected in several places in the same general region by various persons. Erroneously reported as found in Orleans County, New York, and in Newfoundland.

DESCRIPTION. — The root-stock is horizontal and creeping, but very minute. It bears several sterile fronds, and two or

three fertile ones. The sterile fronds are very much contorted and curled. They are not over an inch long, and are very slender. In section they are nearly flat on one face, and slightly convex on the other, and show a single minute central vascular The surface is minutely striated. The fertile fronds are no broader than the sterile, but are a little thicker: they are slightly tortuous, or nearly straight, and rise to the height of three or four inches. The fertile appendage at the top is about a quarter of an inch long: it is ovate in shape, and composed of four to six pairs of oblong-clavate pinnæ, the lowest only two lines long. The two sides of the appendage are usually folded together, at least in the dried specimens. Examined under a microscope, each pinna of the appendage is found to be concave, or boat-shaped, having a broad thickened keel, and thin sides composed of obliquely-placed elongated transparent cells. The margin bears a few one-celled amber-colored flattened hairs. Resting in the boat, like a double row of jugs, are eight or ten ovate sporangia, their side-walls of oblong, tortuous-margined cells, and the ring represented by a radiated apical cap. The spores are ovoid-reniform, and have a smooth surface.

The genus Schizæa consists of about sixteen species, most of them tropical or sub-tropical. One species occurs in the Falkland and Auckland Islands, two in New Zealand, two in Cape Colony, and several in South America.

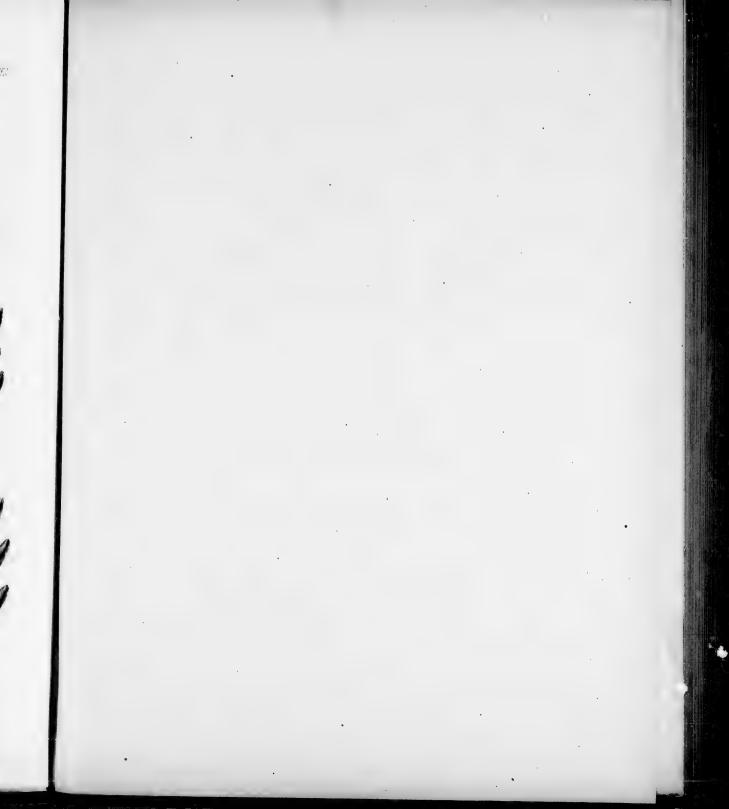
Plate XXIV., Fig. 3. — Schizaa pusilla: — From specimens sent by Mr. C. F. Parker of Camden, New Jersey. The details require no special explanation.

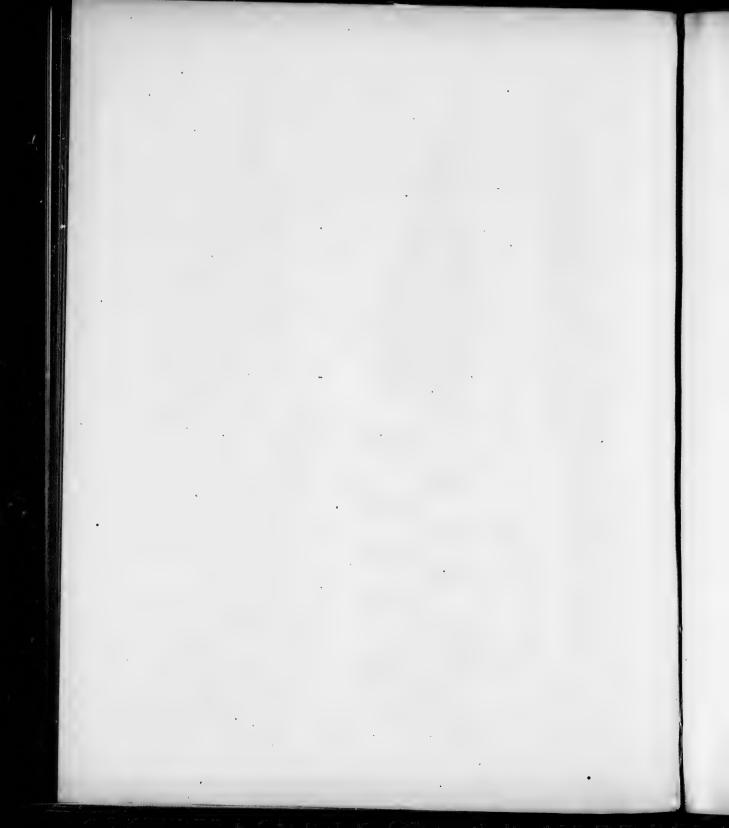




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#### PLATE XXV.

# ASPIDIUM MUNITUM, KAULFUSS.

#### Chamisso's Shield-Fern.

ASPIDIUM MUNITUM: — Root-stock stout, short, ascending; stalks a few inches to a foot long, usually chaffy like the rachis, with abundant glossy-brown ovate-acuminate scales; fronds standing in a crown, sub-coriaceous, evergreen, one to four or five feet long, lanceolate, slightly narrowed at the base, pinnate; pinnæ very many, often chaffy beneath, one to four inches long, linear-acuminate, very sharply and often doubly serrate with incurved aculeate teeth, auricled at the upper side of the nearly sessile base, and obliquely truncate at the lower, all or only the upper ones fertile, but not contracted; veins free, once or twice forked; sori abundant in a row each side the midrib, also on the auricles, often sub-marginal; indusium orbicular, peltate, the margin either entire or incised with hair-pointed teeth.

- Aspidium munitum, Kaulfuss, Enum. Fil., p. 236.— Hooker & Arnott, Bot. Beechey Voy., pp. 162, 405.— Hooker, Fl. Bor. Am., ii., p. 261; Sp. Fil., iv., p. 10, t. 219.— Mettenius, Aspidium, p. 41.— Eaton, Ferns of the South-West, ined.
- Polystichum munitum, Presl, Tent. Pterid., p. 83.—Ruprecht, Dist. Crypt. Vasc. Imp. Ross., p. 39.—Brackenridge, Filices of the U.S. Expl. Exped., p. 203.—Eaton, in Bot. of Mex. Boundary, p. 235.

Nephrodium Plumula, PRESL, Reliq. Haenk., p. 33.

Polystichum Plumula, PRESL, Tent. Pterid., p. 83.

Aspidium aerostichoides, Hooker, in Bentham, Plant. Hartweg., p. 342, not of Swartz, nor of Hooker in Sp. Fil.

Polystichum falcinellum, & Moore, Ind. Fil., p. 97.

Var. nudatum: — Frond smaller, the chaff almost entirely lacking; pinnæ few and rather remote, short and broad, oblong-oval, slightly auricled, the teeth closely appressed; sori scanty, confined to the ends of the few highest pinnæ.

Var. imbricans:— Frond below medium size, not narrowed at the base; pinnæ crowded, lanceolate-oblong, pale, ascending, and imbricated; sori sub-marginal; stalk with lance-acuminate shining brown scales at the base, otherwise almost naked, as are the rachis and frond.

Var. inciso-serratum: — Frond ample; pinnæ lance-acuminate from a conspicuously auricled base, incised with serrated teeth; veins branched into five or six veinlets; sori scattered.

HAB.—Described by Kaulfuss in 1824 from specimens collected near San Francisco in 1816 by Adelbert von Chamisso. It is said, however, to have been gathered many years before at Nutka Sound by Archibald Menzies. It is found among rocks and in forests, sometimes very abundantly, from Guadalupe Island and San Diego, California, northward to British Columbia, but not known east of the Sierra. The finest specimens are from forests near the coast, from Mendocino County, California, to Southern Oregon. Var. nudatum was collected at the Nevada Fall, Yosemite Valley, by Professor Wood. Var. imbricans, in Plumas County, by Mrs. Austin, at Red Mountain, Mendocino County, Dr. Kellogg, and is probably not uncommon. A form connecting these two varieties was found in the Trinity-River mountains by Professor Wood, and at Moore's

Flat, Yuba River, by an unknown collector. Var. inciso-serratum comes from British Columbia, Dr. Lyall and Professor Macoun,

Description.—Chamisso's shield-fern, as it may appropriately be called, is, when well grown and fully fruited, one of the very finest of the North-American ferns. The root-stock is short and thick, and covered with the remains of old stalks, as in most of our Aspidia. The fronds stand in a crown, or circle, and measure from one to five feet high, according to the strength of the plant, and the nature of the climate and soil where it occurs. From one-sixth to one-fourth of this height is in the stalk, which is strong, rounded at the back, and has, when living, a broad shallow channel in front; but in the dried specimen the furrow is deep and narrow. A section shows a broad exterior band of firm tissue, and five interior roundish fibro-vascular bundles, arranged in a curve of two-thirds of a circle, the bundles at the ends of the curve much larger than the other three.

The stalk and rachis are usually very chaffy; but the chaff is nearly or quite wanting, except at the base of the stalk, in the first two varieties named above. The chaff consists of bright-brown ovate-lanceolate acuminate scales, nine to twelve lines long, constantly growing smaller upwards, and intermixed with others very much smaller. The large basal scales appear to have an entire edge, and are usually of one shade of bright glossy brown; but sometimes they are heavier, and with a broad dark-brown median band. The smaller scales are more or less laciniately ciliate, and those of the upper part of the rachis are regularly ciliated.

The fronds are lanceolate in outline, usually a little narrower at the base than in the middle. They are almost coriaceous, and apparently evergreen, since specimens in pretty good order were collected in January, May, August, and November. The color is a good bright green, somewhat paler, or in varieties nudatum and imbricans almost glaucous, beneath. In the normal plant the pinnæ are very numerous, one of Professor Brewer's Crescent-City specimens having over seventy on each side. In these splendid fronds the pinnæ are fully four inches long. nearly straight, wide-spreading, and linear-acuminate from a base which has an acute ovate auricle on the upper side, and is cut away obliquely on the lower. The under surface bears a few minute long-pointed ciliate scales, especially along the midvein and on the veinlets. The margin is sharply serrated with oblique or incurved aculeate teeth, which very often bear a much smaller tooth on each side of the base. The veins are pinnate from the midvein, there being about forty to forty-five principal veins on each side. Each vein is forked near its base, the upper fork or veinlet running unbranched to the margin, and the lower fork divided into two veinlets, the upper one of which, and sometimes the lower also, is commonly again similarly forked. The uppermost veinlet of each group usually bears a sorus rather nearer the margin than the midvein; and in heavily-fruited fronds the lowest veinlet of each group is sometimes also fertile, in this case bearing the sorus still nearer the margin than the primary row of sori.

The sporangia, as they ripen, develop a longer and longer

pedicel, so that, when fully matured, the pedicel is several times as long as the sporangium, and the fruit almost entirely covers the back of the pinnæ. The indusium is orbicular and peltate, as in all the *Aspidia* of the section *Polystichum*. It is usually somewhat jagged at the edge, the teeth running out into slender jointed hairs; but on some plants it seems to be entire, and with no marginal hairs.

Var. *nudatum* is so unlike the type of the species, that, if it had been sent from some other country than California, it would not have been referred to this species. The pinnæ are comparatively few in number, broadly oval-oblong in shape, the auricle scantily developed, and the chaff almost entirely lacking. The base of the stalk is not preserved in the specimens I have seen; but it is very probable that it was covered with narrow scales as in the next variety.

Var. *imbricans*, though chaffy enough at the base, has the frond nearly smooth. The pinnæ are lanceolate-oblong, crowded, very rigid, and usually directed obliquely upwards, so as to lap over each other. It looks like a plant grown in a hot and dry place, and passes by gradations into the type on one side, and into var. *nudatum* on the other.

Var. inciso-serratum corresponds to var. incisum of Aspidium acrostichoides, and is represented by large and broad fronds, with broad pinnæ incised one-third or one-fourth of the way down to the midvein. Each group of veinlets consists of from five to seven, three or four of them often soriferous.

The North-American ferns most closely related to Aspidium

munitum are A. Lonchitis, figured and described in our last part, and A. acrostichoides of the eastern side of the continent. From the former it is distinguished by the usually long and narrow pinnæ, and by the usually much taller fronds being scarcely narrowed at the base. From the latter it differs in the frond being heavier and more coriaceous, and especially in the narrower pinnæ, which are not contracted when they bear fruit.

A much closer resemblance exists between our fern and the A. falcinellum of Madeira. In that species the scales of the stalk are very dark-brown, the pinnæ with a more evident petiole, the auricle obtuse, the serratures not aculeate, and the indusium with a dark spot in the middle. The pinnæ also have a tendency to become auricled on the lower side of the base, as well as the upper.

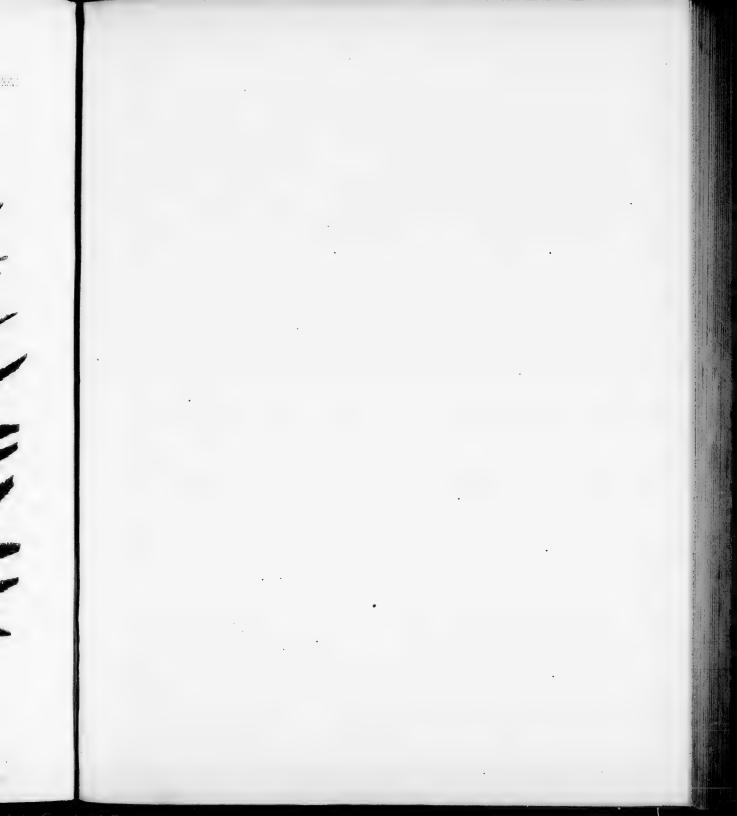
Since our present fern extends to the fiftieth degree of north latitude, and, as Ruprecht thinks, probably much farther north, it is not improbable that it might do well in open-air cultivation in New England.

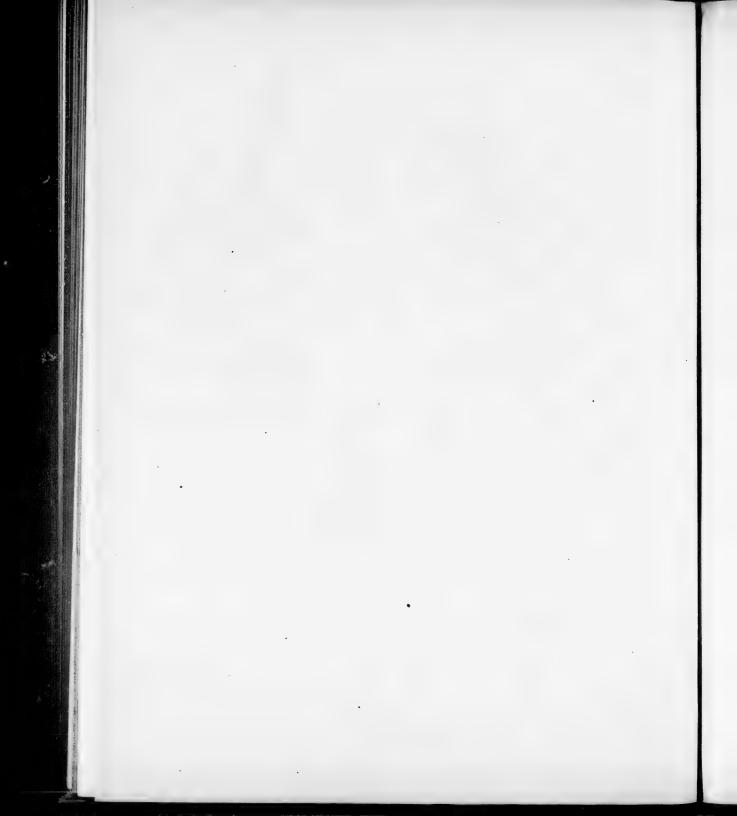
Plate XXV. — Aspidium munitum. The left-hand figure represents a normal but rather small specimen, from Oregon, collected by Mr. E. Hall. The middle frond is var. nudatum, from the Yosemite, Professor Wood. The figure to the right is var. imbricans, from Mendocino County, California, Dr. Kellogg. The small portion of a frond at the top of the plate is from a magnificent specimen collected in 1855 at Port Orford, Oregon, by Lieutenant (now Colonel and Major-General by brevet) August V. Kautz.

The indusium drawn is from this specimen.









#### PLATE XXVI. - Fig. 1.

# POLYPODIUM SCOULERI, Hooker & Greville.

## Scouler's Polypody.

POLYPODIUM SCOULERI: — Root - stock creeping, scaly; stalks rather stout, one to seven inches long; fronds very thick and coriaceous, cartilaginous - margined, smooth, fleshy when recent, two to twelve inches long, broadly ovate, pinnatifid to the midrib; segments linear-oblong, obtuse, obscurely serrulate, the terminal one distinct, and often the longest; veinlets anastomosing, and forming a single series of large areoles with a few free external veinlets; sori very large, borne near the costule, one within each areole, and occurring on the upper segments only, or towards the ends of the other segments also.

Polypodium Scouleri, Hooker & Greville, Ic. Fil., t. lvi. — Hooker, Sp. Fil., v., p. 19. — Hooker & Baker, Syn. Fil., p. 342; Eaton, Ferns of the South-West, ined.

Polypodium carnosum, Kellogg, in Proceed. Cal. Acad., ii., p. 88, fig. 24. Polypodium pachyphyllum, Eaton, in Amer. Jour. Sc. and Arts, July, 1856, p. 138.

HAB.—On trees and stumps, less frequently on the ground; from Guadalupe Island, Dr. PALMER, to the vicinity of Mount Shasta and Crescent City, California, Professor Brewer, and northward to British Columbia.

DESCRIPTION. - The root-stock is creeping, and more or

less elongated; rather thicker than a goose-quill; and, though at first covered with chaffy scales, when old it becomes quite bare, and has then a wrinkled white-pruinose surface. The scales are about four lines long, and taper from a broad base to a very fine Their general color is a deep ferruginous brown; but under a microscope they are seen to be composed of straight oblong cellules of various shades of color, the deep-brown, amber-colored, and transparent ones often mixed together like the stones in a piece of mosaic. The edges are very pale, and minutely ciliate-toothed. The stout and rigid stalks are variable in length, being commonly a little shorter than the fronds they support. A section is broadly rounded on the back and sides, and has a deep and wide channel on the face. It contains four round fibro-vascular bundles, the two nearer the face much larger than the others. The fronds measure from less than two to ten or twelve inches in length, and from an inch and a half to over six inches in breadth. Their general outline is ovate. Their substance is very fleshy when they are fresh, but in the dried specimens coriaceous and rigid. The midrib of the frond and the midveins of the segments are heavy and very prominent beneath. The whole frond has a firm threadlike border, which is decurrent at the base, and continuous with the incurved margins of the furrow of the stalk. On the smallest fronds there are only three or five oval or slightly oblong segments; but in the largest ones there are as many as twelve or thirteen large linear-oblong segments on each side. The seg-

nts are from eight or ten lines to three and a half inches in

length, and from six to eight lines in breadth. The upper ones are separated by very narrow cuttings, which extend almost to the midrib, but the lower ones by broader and rounded sinuses, the lower side of the segments being narrowed, and somewhat decurrent on the midrib. The terminal segment is either distinct, or confluent with but one of its neighbors: it is commonly as large as most of the others. All the segments are obscurely toothed, and are obtuse and rounded at the apex.

The veins are pinnate from the midvein, and each one is forked near the base: the upper fork is undivided; but the lower one bears a branch higher up on the lower side, and is again forked into two terminal veinlets. The last veinlet on the upper side of one group commonly unites with the lowest inferior veinlet of the next higher group, forming an areole, which encloses the lowest superior veinlet of the lower of these two groups. This arrangement of the veinlets is characteristic of the section of the genus to which the name Goniophlebium has been given. In some other species of this section several rows of such areoles are regularly formed. The arrangement, however, is not constant; and a close examination of a frond of the present species (or of many others of the section) will reveal plenty of groups of veinlets which are entirely separate or free, and of course forming no areoles. Hence it is that Goniophlebium, and Phlebodium, Campyloneuron, Phymatodes, and a host of other proposed genera, founded only on differences in venation, and at first received by many good botanists, were disapproved of by the maturer judgment of Hooker, and, after a very full and careful examination by Mettenius, were finally rejected by him and by the majority of scientific pteridologists.

In the present species the sori are found on the upper segments, or sometimes towards the ends of most of the segments. They are very large, far larger than in any other of our native species, being often a fifth of an inch in diameter. The sporangia have very long pedicels. The spores are almost transparent, ovoid with one obtuse ridge,—which is marked by a longitudinal band, or vitta,—and have a minutely roughened or verrucose surface.

Scouler's polypody has a much heavier and more coriaceous frond than any other polypody of our Pacific States, and need never be confounded with any of them. Dr. Scouler's specimens, collected near the Columbia River about forty years ago, are very much smaller than those received from more recent collectors.

Plate XXVI., Fig. 1. — *Polypodium Scouleri*. From an Oregon specimen of medium size. The enlarged fragment shows the peculiar arrangement of the veinlets.

#### PLATE XXVI. - FIG. 2.

## POLYPODIUM INCANUM, SWARTZ.

# Gray Polypody.

POLYPODIUM INCANUM: — Root-stock creeping, rather slender, scaly; stalks slender, one to four inches long, scaly; fronds one to six inches long, six to eighteen lines broad, evergreen, sub-coriaceous, nearly smooth above, beneath thickly dotted with roundish or ovate peltate scales, pinnatifid to the midrib; segments oblong, obtuse, entire, dilated at the base, and separated by rounded sinuses; veinlets free, or making occasional areoles; sori near the margin.

Polypodium incanum, Swartz, Fl. Ind. Occ., iii., p. 1645; Syn. Fil., p. 35.

— Schkuhr, Krypt. Gew., p. 188, t. 11 b (P. velatum). — Willdenow, Sp. Pl., v., p. 174. — Pursh, Fl. Am. Sept., ii., p. 659. — Gray, Manual. — Mettenius, Polypodium, p. 69. — Hooker, Sp. Fil., iv., p. 208. — Eaton, in Chapman's Flora, p. 588. — Grisebach, Fl. Brit. W. I., p. 699. — Hooker & Baker, Syn. Fil., p. 346. — Fournier, Mex. Pl., Crypt., p. 83. — Williamson, Ferns of Kentucky, p. 37, t. v. — Meehan, Native Flowers and Ferns of the U. S., p. 13, t. 4.

Marginaria incana, PRESL, Tent. Pterid., p. 188.

Goniophlebium incanum, J. Smith, "in Hooker's Jour. Bot., iv., p. 56."— Brackenridge, Filices of U. S. Expl. Exped., p. 32.

Lepicystis incana, J. Smith, "in Lond. Jour. Bot., i., p. 195;" Ferns, Brit. and Foreign, p. 80.

Polypodium ceteraccinum, MICHAUX, Fl. Bor. Am., ii., p. 271.

Polypodium Eckloni, Kunze, in Linnæa, x., p. 498. — Mettenius, Polypodium, p. 68. — Hooker, Sp. Fil., iv., p. 209.

Polypodium incanoides, Fée, 8<sup>me</sup> Mém., p. 88; Foug. Mex., p. 20, n. 12. Acrostichum polypodioides, LINNÆUS, Sp. Pl., p. 1525.

Acrostichum fronde pinnata: foliolis linearibus alternis sessilibus, terminatrice plerumque trifida, Gronovius, Fl. Virg., p. 198.

HAB.—On trunks of trees and on old roofs, more rarely on rocks, from Florida to Texas, and extending northwards to the Natural Bridge, Virginia, MEEHAN, Wirt County, West Virginia, H. N. MERTZ, and to a few places in the southern parts of Ohio, Indiana, and Illinois. Common in the West Indies, and from Mexico to Brazil and Chili. Also in South Africa and in Tropical East Africa.

Description.—The gray polypody, hoary polypody, or scaly polypody, as it has been variously called, though properly a tropical fern, yet occurs so far north, that it must occasionally have to withstand a severe frost. It commonly grows in large mats, the creeping root-stocks very much entangled. These root-stocks are about a line and a half in thickness, and are at first covered with ovate-acuminate scales, which are peltately attached near the base, and have a dark-brown rigid median band surrounded by a hyaline laciniately ciliate border. Afterwards the border wears away, then the long point of the scale breaks off, and at last the root-stock is left nearly bare. The stalks are slender, and are at first covered with scales like those of the root-stock; but these fall off, and there remain ovate and rounded scales intermixed, all with a dark centre and a nearly transparent

border. The fronds have a leathery texture, are dark-green in color, nearly or quite smooth above, and beneath copiously sprinkled with scales like those of the stalk, the rounded ones predominating. In many tropical American plants, however, the fronds bear an abundance of long-pointed scales. The fronds are capable of withstanding drought, and are often found curled up, and apparently dead; but when they are moistened they uncoil themselves, and are as fresh and green as ever. They are commonly in the United States about three inches long, and nearly half as wide; but fronds both much smaller and considerably larger are often seen, especially in foreign specimens. The segments are from four to twenty on each side, oblong-linear or sometimes a little obovate in shape, entire, and obtuse, the lowest ones rarely a little shorter than the middle ones. They are separated by rounded bays which reach quite to the midrib.

The venation varies in different plants, and is difficult to be seen, as the fronds are very opaque: it is, however, generally free, each vein forked near the base, the upper veinlet simple, and the lower one again forked; but occasionally, especially in tropical plants, the veinlets are united near the margin, forming areoles. The fruit-dots are rather small, round and naked, and placed at the end of the upper forks of the veins; and, as the segments of the fronds are often made concave by drought, the fruit-dots appear to be marginal. The spores are light-colored, ovoid-bean-shaped, indistinctly vittate along one side, the surface sprinkled with minute pale-yellowish granules.

This little fern is by no means particular in its choice of a

home. Though perhaps oftenest seen on trees, it is recorded as growing also on rocks, old walls, and even on roofs, as at St. Augustine, Florida, where a roof was heavily thatched with it. In Kentucky it grows, as Mr. Williamson tells us, on trees and on rocks. The West-Virginia station is a very recent discovery, and is perhaps the most northern of all, being in north latitude 39°. Mr. Mertz writes: "It is on a high, dry cliff: the fern grows on the edge of the rock, and down the face for a little distance, fully exposed to the sun's rays."

The scaly *Polypodia*, with veinlets more or less anastomosed and forming simple arcoles, have been put into a genus by themselves by Mr. John Smith, and named *Lepicystis*. There are some half-dozen of them, mostly occurring in the warmer countries of America; but in respect to neither venation nor the scales can they be separated from the other unquestioned *Polypodia*.

Plate XXVI., Fig. 2. — Polypodium incanum. From a Florida specimen.

## PLATE XXVI. - Fig. 3.

# POLYPODIUM FALCATUM, KELLOGG.

# Kellogg's Polypody.

POLYPODIUM FALCATUM: — Stalks slender, stramineous when dried; fronds broadly lanceolate, nine to fifteen inches long, four to six broad, thin-membranaceous, smooth, pinnatifid to the midrib; segments numerous, tapering from a dilated base to a very long and attenuated point, often falcate, sharply serrate, the lower ones slightly reduced and separated by very broad sinuses, the upper ones by acute incisions, the terminal one acuminate; veins with about four free veinlets; sori medium-sized, nearer the midvein than the margin.

Polypodium falcatum, Kellogg, in Proc. Cal. Acad., i., p. 20 (Dec. 1854). Polypodium Glycyrrhiza, Eaton, in Am. Jour. Sci. and Arts, July, 1856, p. 138.

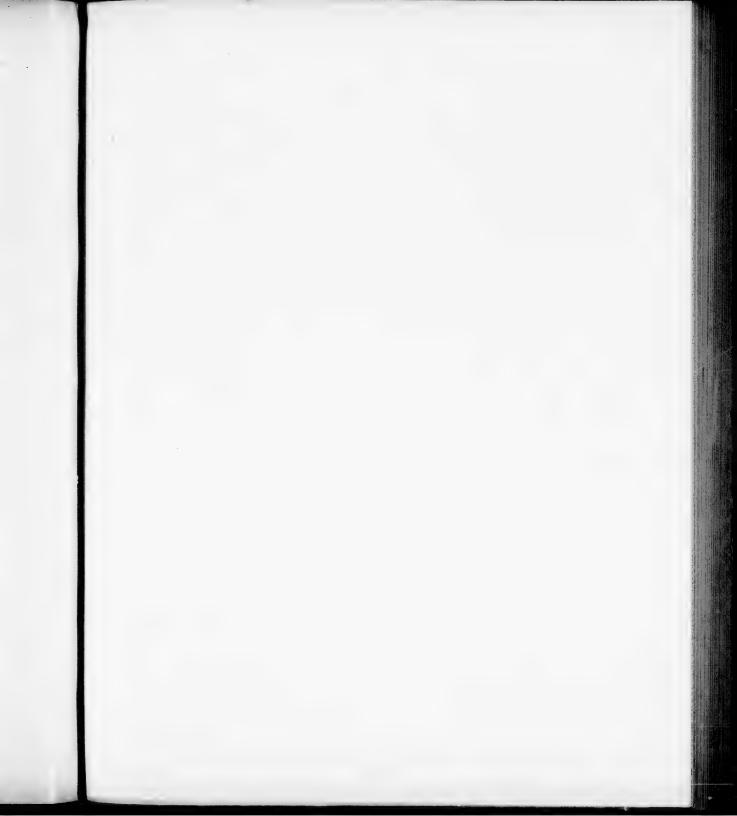
HAB. — On trees, sometimes seen in clefts of rocks, Shoalwater Bay, Washington Territory, Mr. J. G. SWAN; near Port Orford, Oregon, General KAUTZ.

Description. — The root-stock I have not seen. Dr. Kellogg described it as "compressed tuberculate, one-fourth to one-eighth inch broad, greenish russet-color, branching laterally, often covered with scales." General (then Lieutenant) Kautz noted that "the root is used as an emollient and expectorant; the

taste resembles liquorice:" and Dr. Kellogg has a very similar remark. The stalk is probably several inches long: it is rather slender, smooth, and, when dried, is straw-colored. The fronds are ample, generally over a foot long, and are broader in the middle than at the base. They are much thinner in texture than those of P. vulgare, to which Mr. Baker has referred the plant. In a large frond there are about twenty-two segments on each side, mostly alternate, the lower ones distant, and much dilated on each side of the base: the upper ones are placed closer together, and are less dilated. The middle segments are over three inches long; and all of them, the terminal one included, are sharply serrate, and narrowed very gradually to an attenuated point. The veins fork near the midvein, having the upper fork simple, and the lower divided into three veinlets, which are always free. The fruit-dots are numerous on the upper half of the frond, but do not extend to the narrow tips of the segments. The spores are reniform-ovoid, and minutely verrucose on the surface.

I have seen but very few fronds of this fern, and it does not seem to have been gathered by recent collectors; but I am still disposed to consider it a distinct species.

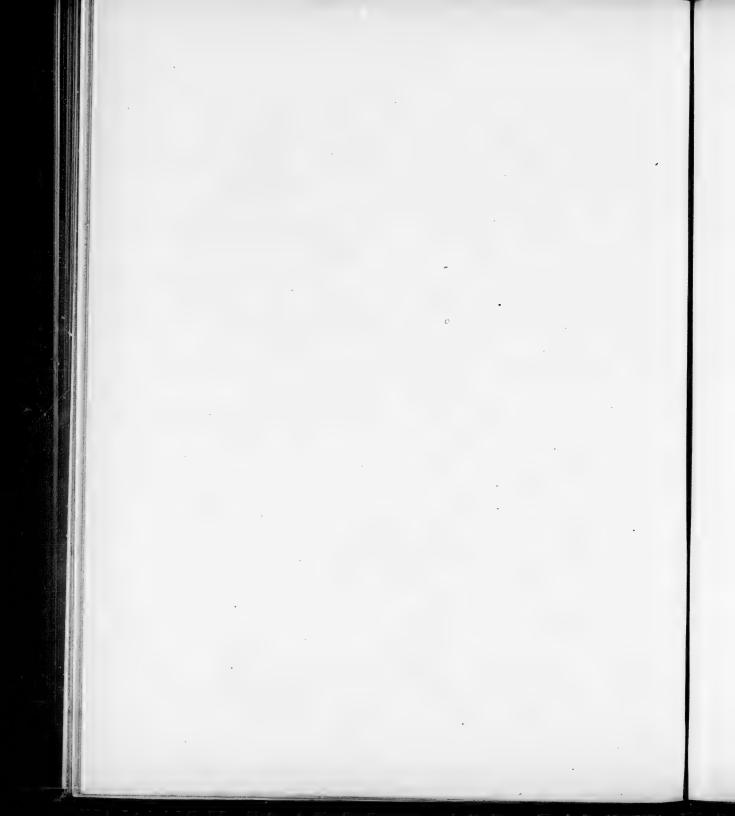
The frond drawn is a small one collected by General Kautz.





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# PLATE XXVII. - Fig. 1.

# PELLÆA ANDROMEDÆFOLIA, Fée.

#### Andromeda Cliff-Brake.

Pellæa andromedæfolia: — Root-stock slender, creeping, covered with narrow ferruginous scales; stalks scattered, erect, wiry, smooth, pale-brown, chaffy only at the base, two to twelve inches long; fronds about equalling the stalks, somewhat rigid, ovate, twice to four times pinnate; primary pinnæ rather distant, spreading, ovate-lanceolate; ultimate pinnules sub-coriaceous, smooth, slightly glaucous, petiolulate or sessile, two to five lines long, broadly oval, slightly cordate and emarginate, fertile ones often with the edges revolute to the midvein; veins six to eight pairs, commonly twice forked, the veinlets nearly at right angles to the midvein, and sometimes producing narrow ridges on the upper surface; sori at the ends of the veinlets, involucre formed of the margin of the frond, herbaceous with a narrow whitish edge.

- Pellæa andromedæfolia, Fée, Gen. Fil., p. 129. HOOKER, Sp. Fil., ii., p. 149. EATON, in Bot. Mex. Boundary, p. 233. HOOKER & BAKER, Syn. Fil., p. 150.
- Pteris andromedæfolia, Kaulfuss, Enum. Fil., p. 188. Hooker & Arnott, Bot. Beechey's Voy., p. 406.
- Allosorus andromedæfolius, Kaulfuss, "Herb. & Catal.;" Kunze, in Linnæa, ix., p. 56, x., p. 503; Analecta Pteridogr., p. 18, t. xi.; Torrey, Pacif. R. Rep., iv., p. 159.

Platyloma andromeda folium, J. Smith in Hooker's Lond. Jour. Bot., iv., p. 160. — Brackenridge, Filices of U. S. Expl. Exp., p. 94. Crypteris divaricata and C. pubescens, Nuttall, in Herb. Hook. Pellaa myrtillifolia, Mettenius; Kuhn, in Linnaa, xxvi., p. 85 (the Chilian plant).

HAB.—Exposed rocks in ravines and cañons, sometimes growing on hillsides; California, mostly in the Coast Ranges, possibly extending to Arizona and North-western Mexico. I know of no specimens collected north of Californian, those sent by Capt. Wallace from "Frazer's River" being probably Californian. The fern re-appears in Chili and in South Africa.

DESCRIPTION. — The root-stock is a few inches long, fleshy when living, but rigid when dried, round, and covered with rusty-brown somewhat crisped narrow chaffy scales. The stalks are scattered along the root-stock, erect, wiry, terete, light-reddish-brown, with a delicate bloom when fresh, duller when dry, chaffy only at the very base. The fibro-vascular bundle is very peculiar, and deserves special microscopic study. It is central, roundish-triangular, with slightly impressed sides, the interior part containing a three-armed projection from the middle of one of the sides.

The frond is broadly triangular-ovate in outline, from a few inches to over a foot in length, and usually thrice pinnate, but sometimes four times pinnate at the base. The rachis is usually terete like the stalk, but is sometimes slightly flattened or even obscurely channelled on the upper side. Though commonly straight, it becomes a little flexuous when the pinnæ are

alternate. The lower pinnæ are distant, ovate-lanceolate, shortstalked, and commonly bi-pinnate; the upper ones gradually shorter and simpler, and several of the uppermost reduced to single leaflets. The leaflets, or ultimate pinnules, are dullgreen above, paler and somewhat glaucous beneath, sub-coriaceous, oval or ovate, and usually slightly cordate at the base, and faintly notched at the rounded apex. Their length is from two to five or even eight lines. In the sterile fronds they are perfectly flat, and have a faint narrow whitish border; but in the fertile fronds, which are much commoner, the margin is rolled under so as to cover the sporangia, and the whitish border becomes more distinct, and like an involucre. Very often the pinnules have their edges rolled under clear to the midvein, so that they are pod-like, and the fruit is completely hidden. In each pinnule there is a central vein, and several widely divergent veins on each side. These veins are forked near the midvein, and their branches often forked again. The veinlets are straight, and, when the pinnules are rolled up, often appear as minute striations on the upper surface. The sporangia are seated on the tips of the veinlets, and form a band along the sides of the pinnules just beneath the revolute margins. The spores are trihedric-globose, and appear to be roughened with irregular reticulating ridges.

While the frond, with its rachis and branches, is usually smooth, and even colored with a faint plum-like bloom, it is sometimes slightly pubescent, and is then the var. *pubescens* of Baker (Syn. Fil., l. c.), the *Crypteris pubescens* of Nuttall.

The specific name, andromedafolia, undoubtedly has reference to the revolute pinnules, often somewhat glaucous beneath. In this respect they resemble the foliage of Andromeda polifolia, though not in shape, as the leaves of the Andromeda are usually linear-lanceolate. Linnæus chose the name Andromeda for the pretty ericaceous shrub of the North because it was so beautiful of face (corolla), was fastened to a rock, environed by water where he first found it in Lapland, surrounded by dragons (reptiles), and held up its most innocent arms (branches) piteously to heaven, and so remained until most welcome Perseus (the summer sunshine), by drying up the floods of spring, should release the fair prisoner. The Andromeda fern, too, is commonly chained to a rock; but in no other respect can we trace an analogy to the daughter of Cassiope.

In cultivation at the East, *Pellaa andromedæfolia* becomes larger, more compound, and has longer-stalked pinnæ and pinnules, than in its native home.

Plate XXVII., Fig. 1.—Pellæa andromedæfolia. From a specimen collected near Santa Barbara by Mrs. Cooper. The fragment in fruit is from a specimen from Monte Diablo.

<sup>&</sup>lt;sup>1</sup> The curious reader is referred to Flora Lapponica, ed. ii., p. 133, and to Lachesis Lapponica, vol. i., pp. 188, 189, for other details of this fanciful comparison.

#### PLATE XXVII. - Fig. 2.

# PELLÆA FLEXUOSA, LINK.

## Zigzag Cliff-Brake.

Pellæa flexuosa: — Root-stock creeping, rather slender, the scales narrow, rigid, brown, with a darker midrib; stalk red-dish-stramineous, several inches long, rigid, more or less furrowed along the front, passing into a more or less flexuose or zigzag rachis; fronds from six inches to over two feet long, ovate-oblong in outline, twice, or the larger ones thrice, pinnate; secondary and tertiary rachises usually deflected and zigzag, rusty-puberulent, or nearly smooth; pinnæ commonly alternate; ultimate pinnules five to ten lines long, roundishovate or sub-cordate, very obtuse, distinctly petiolulate, sub-coriaceous, smooth, slightly glaucous beneath; margin of the fertile pinnules at first recurved and partly covering the sporangia, at length flattened out.

- Pellea flexuosa, Link, Fil. Hort. Berol., p. 60.—Hooker, Sp. Fil., ii., p. 149.—Fée, Gen. Fil., p. 129.—Fournier, Pl. Mex., Crypt., p. 118.
- Pteris flexuosa, Kaulfuss, "MS.," and in Linnæa, v., p. 614 (excluding synonymy). Hooker, Ic. Pl., t. 119.
- Allosorus flexuosus, Kaulfuss, "MS." Kunze, in Linnæa, xiii., p. 136.

   Die Farrnk, i., p. 46, t. 23.

Platyloma flexuosum, J. Smith.

Pellæa cordata, β flexuosa, Hooker & Baker, Syn. Fil., p. 153.

Pellæa intermedia, Mettenius. — Kuhn, in Linnæa, xxxvi., p. 84.

HAB. — From Austin, Texas, to San Diego County, California, probably in exposed rocky places. Mexico to Peru.

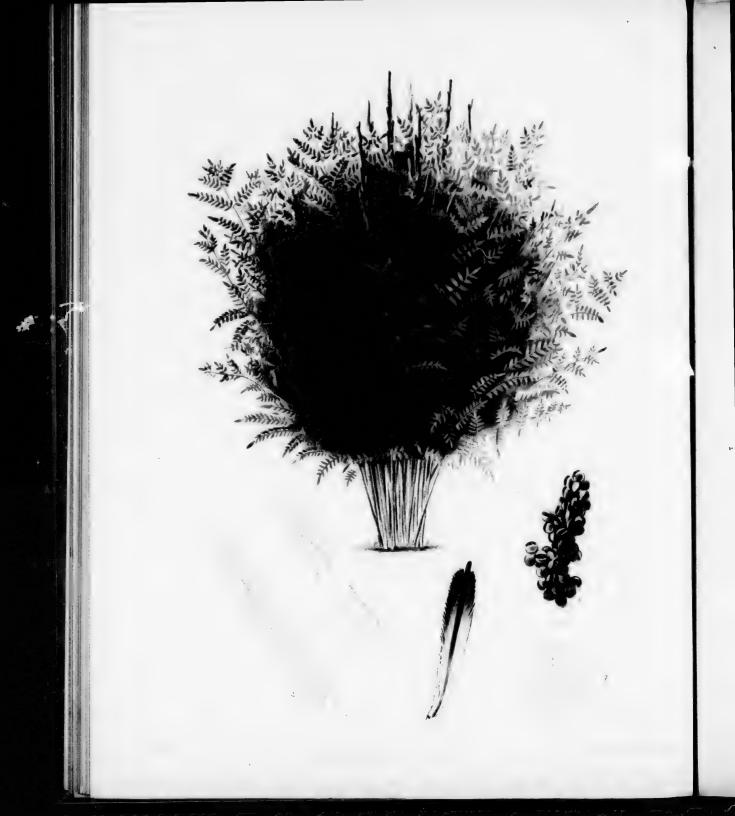
Description.—This is commonly a larger and more rigid fern than the last, having also a pale reddish-brown stalk, and ovate or cordate-ovate obtuse but decidedly larger pinnules. The rachis and all its parts are normally very flexuose, or bent from side to side in a zigzag manner. The stalk is much like that of *P. andromedæfolia*, but is more decidedly flattened on one side; and the fibro-vascular bundle is the shape of the expanded wings of a butterfly, having two large spots on the front edge of the fore-wings, and the body represented by a V-shaped projection from the upper side.

The band of sporangia is very broad, and the recurved margin of the fruiting pinnules very narrow. The spores are globose and minutely warty, or almost muricated.

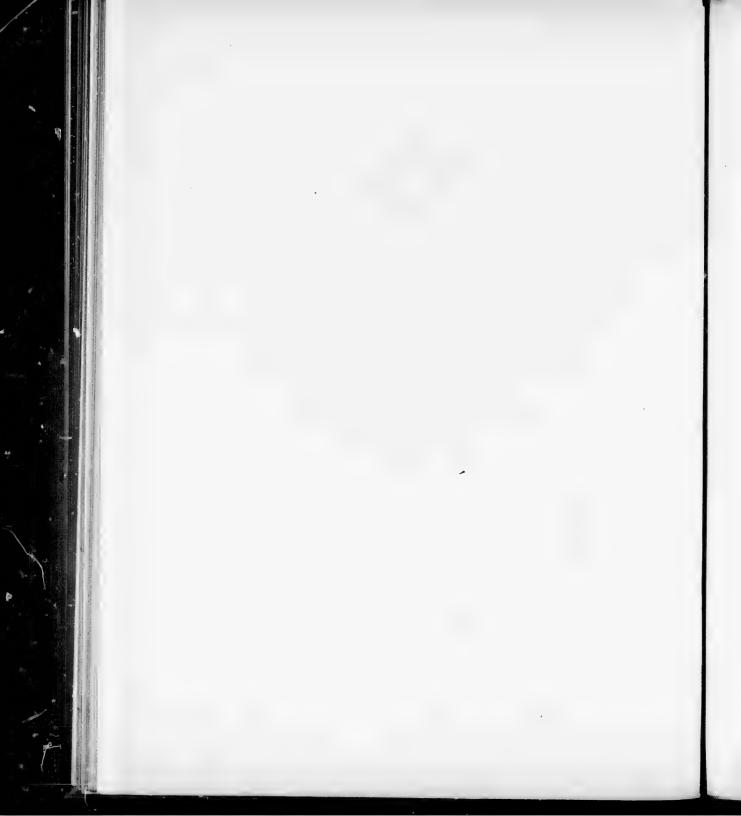
Mr. Baker considers this plant a variety of *P. cordata*, which has a straight rachis and plainly cordate or even sagittate pinnules. The latter species is found from Mexico to Ecuador.

Mr. Emerton's characteristic drawing is taken from a specimen collected by the botanists of the Mexican Boundary Survey.









### PLATE XXVIII.

# OSMUNDA REGALIS, LINNÆUS.

### Royal Fern.

OSMUNDA REGALIS: — Root-stock creeping, massive with imbricated stalk-bases; stalks erect, several inches to two feet high, rounded on the back, slightly flattened in front, never chaffy; fronds a few inches to several feet long, ovate-oblong in outline, bi-pinnate; pinnæ mostly opposite, the lower ones distant; pinnules sub-coriaceous, commonly smooth, distinct, short-petioled or sub-sessile, oval, oblong or oblong-lanceolate; the base rounded, or obliquely truncate, or sub-cordate, often somewhat auricled, especially on the lower side, the edges commonly crenulate-serrulate, the apex obtuse or sub-acute; fertile fronds with several of the uppermost pinnæ contracted and bi-pinnate, the slender divisions destitute of green leaf-tissue, and covered with bright-brown bi-valvular sporangia having a reticulated surface.

Osmunda regalis, Linneus, Sp. Pl., p. 1521. — Swartz, Syn. Fil., p. 160. — Schkuhr, Krypt. Gew., p. 147. t. 145. — Whldenow, Sp. Pl., v., p. 97. — Michaux, Fl. Bor. Am., ii., p. 273. — Presl., Suppl., p. 62. — Newman, Hist. Brit. Ferns, p. 308. — Moore, Nat. Pr. Brit. Ferns, t. 50. — Gray, Manual, ed. ii., iii., iv., p. 600; ed. v., p. 670. — Eaton, in Chapman's Fl., p. 598. — Hooker, Brit. Ferns, t. 45. — Milde, in Nov. Act. Acad. Nat. Cur., xxvi., ii.,

- p. 647; Fil. Eur. et Atl., p. 175; Monogr. Gen. Osmundæ, p. 58, t. i., ii., iii., f. r-64. Miquel, Prolus. Fl. Japon., in Ann. Mus. Bot. Lugd.-Batav., iii., p. 181. Hooker & Baker, Syn. Fil., p. 427. Fournier, Pl. Mex., Crypt., p. 140. Williamson, Ferns of Kentucky, p. 133, t. lii.
- Osmunda Japonica, Thunberg, Fl. Jap., p. 330.—Swartz, Syn. Fil., p. 161.—Willdenow, Sp. Pl., v., 99.—Eaton, in Perry's Exp., ii., p. 330. (Eastern Asia; the fertile fronds with no sterile pinnæ.)
- Osmunda spectabilis, Willdenow, Sp. Pl., v., p. 98.—Pursh, Fl. Am. Sept., ii., p. 658.—Link, Fil. Hort. Berol., p. 19.—Hooker. Fl. Bor.-Am., ii., p. 265.—Torrey, Fl. New York, ii., p. 504.—Presl, Suppl., p. 63.—Gray, Manual, ed. i., p. 634. (Eastern North America.)
- Osmunda palustris, Schrader, "in Götting. gelehrt. Anz. (1824), p. 866." Link, Fil. Hort. Berol., p. 20. Sturm, Fl. Bras., Fasc. xxiii., p. 165. (Brazil.)
- Osmunda obtusifolia, Willdenow, "Herb." Kaulfuss, Enum. Fil., p. 43.
   Presl, Suppl., p. 65. (Mauritius.)
- Osmunda glaucescens, Link, Fil. Hort. Berol., p. 20. Presl, Suppl., p. 65. Mettenius, Fil. Hort. Lips., p. 116. (North America; the stalk glaucous near the base.)
- Osmunda gracilis, Link, "Hort. Berol., 2, p. 145;" Fil. Hort. Berol., p. 20. Kunze, Die Farrnkraüter, i., p. 81, t. xxxix. Presl., Suppl., p. 64. Mettenius, Fil. Hort. Lips., p. 116. (Brazil.) Osmunda Hügeliana, Presl., Suppl., p. 64. (India.)

<sup>&</sup>lt;sup>1</sup> The ferns of this *Prolusio* have been referred to once or twice in the present work (as on pp. 136 and 147) as having been prepared by Mettenius. The author was the late Dr. F. A. W. Miquel, Professor of Botany at Utrecht.

Osmunda capensis, Presl, Suppl., p. 63. (South Africa.)

Osmunda speciosa. "Wallich, Catal., n. 50." — Presl, Suppl., p. 64.

Filix florida, seu Osmunda regalis foliis alternis, surculis seminiferis,

Gronovius, Fl. Virg., p. 123.

HAB. — In marshes and wet woods, and by the margins of ponds and streams; very common from Newfoundland and New Brunswick, through Canada westward to the Saskatchewan, and in the United States from Maine to Florida, extending to Lake Superior and Louisiana. Mexico and Cuba to Brazil. Europe, Asia, Africa, and the Mauritius. Apparently absent from the western side of both the American continents, unless possibly it is in the Sierra Madre of North-western Mexico.

Description.—The root-stock creeps just beneath the surface of the ground, or even at the surface, advancing an inch or so every year, and slowly decaying at the older extremity. The existence of a plant probably continues many years, as the old and decayed remains of the root-stock may sometimes be traced for two or three feet. The root-stock itself is slender, scarcely more than two lines in thickness; but it is so covered with imbricating stalk-bases and by interlacing roots, that the whole is massive, and often has a diameter of two or three inches.

The stalks are continuous with the root-stock, and indeed inseparably united with it: the part above ground is roundish, but flattened on the upper or anterior side, and smooth, except for a little pale-brown deciduous cobwebby wool. The single fibro-vascular bundle is in section horseshoe-shaped, with in-

curved edges. The plant is devoid of chaff; but the base of the stalks is dilated on both sides, so as to form a pair of broad stipular wings. These wings are peculiar to the Osmundaceæ among ferns, and are curiously analogous to the stipules of some Phænogamous plants. In the terminal bud of the root-stock they are found of all degrees of development, each one inwrapping those less developed than itself, like the scales of an onion. The central part is thickest, and made stiff by dark hard tissue; but the sides grow thinner, and at the edges are a most delicate membrane. All but the fibro-vascular midrib, and a few veins which diverge from it obliquely, are white, fleshy, and gorged with starch-grains oval or roundish in shape, and of very different sizes, the exceedingly minute and the larger ones commingled. Between the stipular bud-coatings are layers of fine wool, densely packed away, and apparently mixed with starchy tissue; but of this I am not quite sure. The apex of the scale bears a rudimentary frond, coiled up circinately, as in most ferns. When the frond is full-grown, the edges of the wings become scarious, and the oblique striations of firm tissue more evident. After a while the edges of the wings become ragged, and are torn away; but the middle part continues white and fleshy for a long time. The root-stock sends out strong blackish rootlets, some of which creep upward between the scales, and others pierce directly through them, thus binding the whole together, giving it great strength and solidity, and taking so firm a hold upon the soil, that a strong man finds it no easy task to tear the plant from the ground. The wings are, of course, decidedly concave; but their general shape is that of a barbed arrow-head. They are from two to two and a half inches long, and three-fourths of an inch broad at the widest part.

The fronds of the royal fern are said to attain the height of ten or eleven feet in the British Islands; but the highest that I have ever seen were from the valley of the Connecticut River, and measured six feet from the ground. Fronds four or five feet high are not at all rare; but more commonly the fronds, including the stalk, which is nearly as long as the frond itself, stand from two to four feet high. In dryish marshes they are often not more than a foot or fifteen inches high, and stand perfectly erect; but in plants of full size the fronds curve outward in all directions, and form an object of such stately beauty, that the plant well deserves its name of royal fern.

The color of this fern is usually a full herbaceous green, but it is often somewhat glaucous, especially on the stalk and rachis; and, when grown in sunny marshes, the young fronds are often tinged with various shades of reddish-orange and brownish-red. The sterile fronds are broadly ovate-oblong in outline, and exactly bi-pinnate. The primary pinnæ usually number from seven to nine pairs, of which two or three of the uppermost are reduced to simple leaflets; and the rest bear from six to twelve pinnules on each side, beside the terminal ones. The lower pinnæ of a large frond are often a foot long, and the lowest pair separated from the next by an interval of four or five inches. The second pair of pinnæ are nearly or

quite as large as the lowest pair, and the size scarcely diminishes till the fourth or fifth pair is reached. The pinnæ have evident stalks, commonly two to four lines long: they are usually exactly opposite, but may sometimes be found separated as much as half an inch. The secondary pinnæ, pinnules, or leaflets, are perfectly smooth, and of a rather firm chartaceous texture: they vary a good deal in shape and in size, and many supposed species have been founded principally upon differences of this kind; but, to any person who will devote a day to gathering fronds of this fern in the marshes and along the waters of almost any township in New England, it will appear a useless and superfluous task to try to distinguish even any wellmarked varieties. The pinnules vary in length from three-quarters of an inch to two inches and a quarter (in plants of the United States), and in breadth from three lines to eight, the shorter ones being not always the narrowest. The commonest shape is oval-oblong, rounded at the apex, and the base unequal, being obliquely truncate or broadly rounded on the upper side, and more or less cordate on the lower. Other fronds, especially those from Florida and the Carolinas, will have oblong-lanceolate pinnules, with the apex sub-acute, and the base very unequal. Sometimes both sides of the base are cordate, and specimens with a distinct rounded auricle on the lower side of the base are by no means lacking. The absence of this auricle was formerly relied on to distinguish the American O. spectabilis from the European O. regalis; but, while the auricle is certainly less common here than in Europe, it may readily be found in almost any district, and it is certainly impossible by its aid to separate the plants of the two continents. The edges of the pinnules are commonly finely crenulate-serrulate; but sometimes the serrulations are scarcely perceptible. Besides the auricle just referred to, the margin of the pinnules occasionally bears two or three short rounded lobes in its lower half, just as is often the case in European specimens.

The veins are free, and usually fork once close to the midvein, and the upper veinlet again before reaching the margin; but in broader pinnules the lower veinlet is also forked; and, if the pinnule be auricled or lobed, the forking will be repeated a third and even a fourth time. The apices of the veins end most frequently in the sinuses between the teeth, but sometimes in the points of the teeth, as in Milde's European var. acuminata.

The fertile fronds are of the same height as the others, and usually have the three or four lower pairs of pinnæ exactly like those of the sterile fronds; but the upper part is transformed into a bipinnate or tripinnate panicled mass of fructification. In the normal fructiferous panicle the greenleaf tissue is entirely wanting, the ultimate divisions being all thread-like, containing no chlorophyll, and entirely covered with sporangia. But it frequently happens that some of the pinnæ are but partly contracted, and produce abundant sporangia along their margins, while yet preserving a truly foliaceous character. This may happen either at the base of the panicle, or in its upper portion: when the latter is the case the upper-

most pinnæ are usually entirely foliaceous and sterile, and the frond is an example of the var. interrupta of Milde. But in Japan and India a plant is found, the O. Faponica of Thunberg, and O. speciosa of Wallich, in which the fertile frond is fertile throughout its whole length. But this complete separation of sterile and fertile fronds does not seem to be absolutely constant; and while the plant may properly be called var. Faponica, as by Milde, or var. biformis, as by Bentham (in the Flora of Hongkong), the distinction is not now considered to be of specific importance. The same form occurs also in China and in Natal. The sporangia, as of all the Osmundaceæ, are much larger than in polypodiaceous ferns, and the ring is reduced to a mere patch of cellules slightly different from the rest of the cellules of which the sporangium is composed. The sporangia are short-pedicelled, and obovate-spherical in shape. They open by a longitudinal cleft along the front, the opening extending over the top to the vestige of the ring, thus dividing into two equal hemispherical valves. The spores are tetrahedric-spherical, with three vittæ which meet at the angular side of the spore. The surface is granulose, and the color a very pale green.

Milde describes no less than fourteen varieties of the royal fern, giving to North America his var. spectabilis, which he makes identical with O. glaucescens, and crediting us also with an occasional plant of var. palustris, and even of the commonest European form, which he calls "Forma obtusiuscula." But it seems more reasonable to recognize only the species O. regalis, and possibly the diplotaxic var. Faponica.

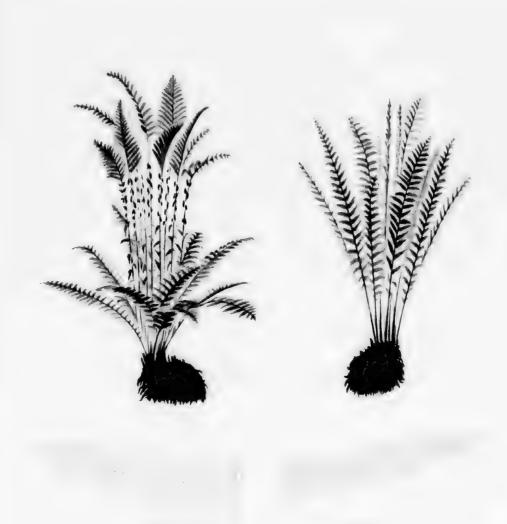
The genus Osmunda comprises six or seven species: one of them is found in Europe, the same one in Africa, three in America, and all in Asia. Two other genera are associated in the same sub-order: viz., Todea, represented by a single species which occurs in South Africa, Australia, and New Zealand; and Leptopteris, which has two species in New Zealand, and one in Australia, New Caledonia, the Feejee Islands, etc. In Osmunda the sporangia are borne normally on contracted branchlets destitute of green leaf-tissue. Todea has the sporangia on the back of the green sub-coriaceous frond; and Leptopteris has the sporangia similarly placed on the back of the frond, but the frond is delicately pellucid like the Hymenophyllaceae. All the genera have the stalk winged at the base, much as in O. regalis.

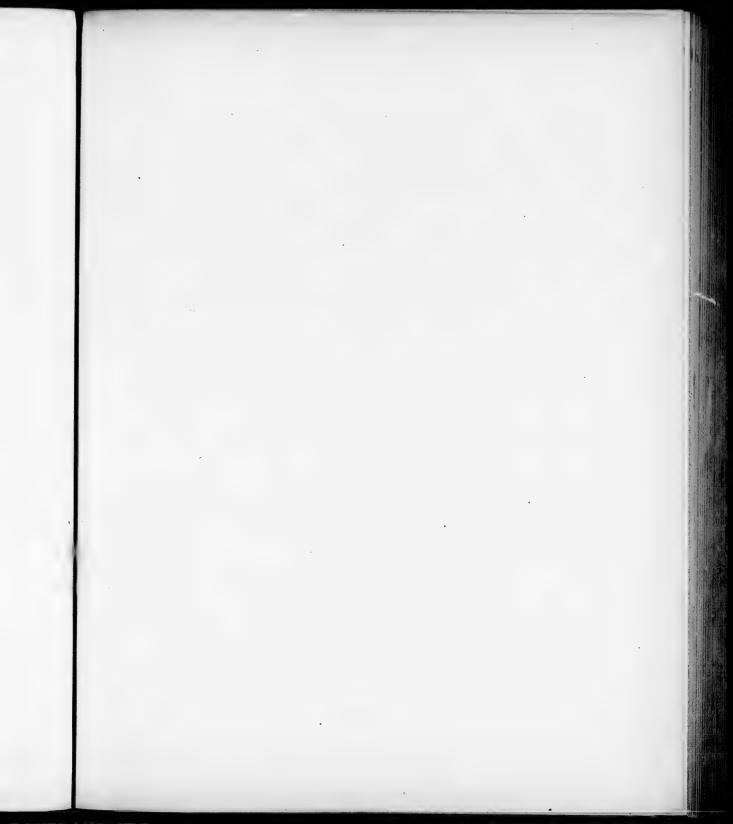
The name Osmunda is of uncertain origin. Dr. Gray says that Osmunder was a Saxon name of the divinity Thor. Sir W. J. Hooker (British Ferns, at t. 45) refers to Sir James Edward Smith's conjecture that the word comes from the Saxon Osmund, meaning "domestic peace." He also quotes from Gerarde that "in olden time it was called Osmund the Waterman, and the whitish portion of the root-stock (which, boiled, or else stamped, and taken with some kind of liquor, is thought to be good for those that are wounded, dry-beaten, and bruised, or that have fallen from some high place) is called the heart of Osmund the Waterman." Another old name was St. Christopher's Herb. Hooker says further: "Now, as we know St. Christopher was the patron saint of watermen, and probably

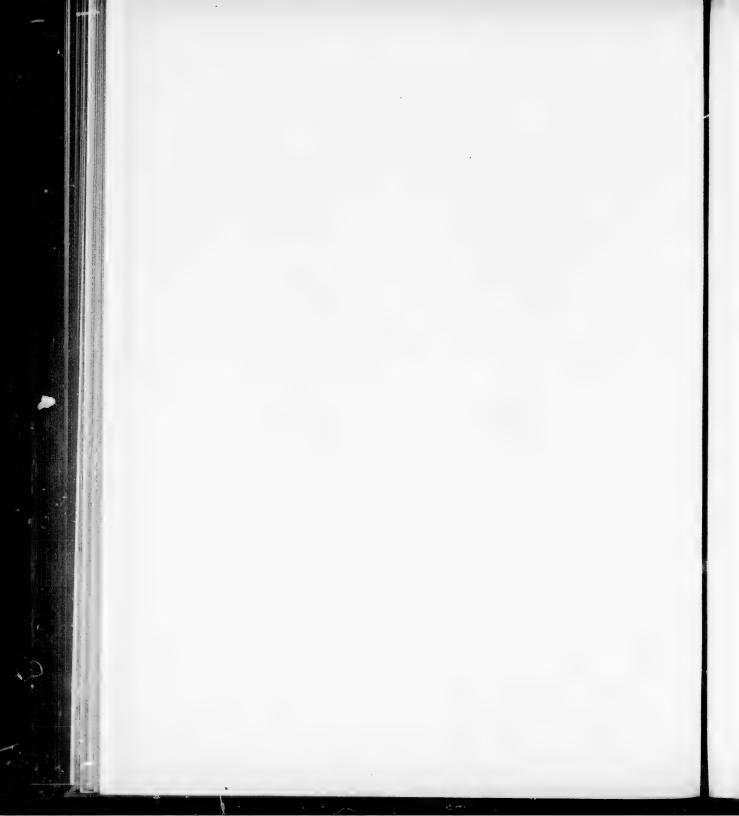
of water-plants, so St. Osmund might be equally venerated under like circumstances, could we know more of his history than is handed down to us. And a saint of that name did come over from Normandy in 1066 with William the Conqueror, and one of some celebrity too; for he was made Chancellor of the kingdom, and Bishop of Salisbury, where he 'reformed the liturgy for the diocese, which afterwards became general throughout the kingdom, under the name of the Salisbury Liturgy.' Such a saint deserves to have his name handed down to posterity in so truly noble a British fern." Still another Osmund, and a saintly man too, appears to have been a waterman, and a dweller at Loch Tyne. A story of his adventures is related in Williamson's "Ferns of Kentucky." A little more about the name is given by Milde (Monogr. Gen. Osmundæ, p. 55).

Plate XXVIII. — Osmunda regalis, from a fine plant in the grounds of John Robinson, Esq., at Salem, Massachusetts. The plant is drawn about one-eighth the natural size. Fig. 2 shows the base of a mature stalk with the stipular dilation, though the wing is not so wide as when the frond is first developed. Fig. 3.—A pinnule of the form commonest in the northern United States. Fig. 4.—An elongated pinnule, somewhat auricled on the lower side of the base, from a plant found at Beverly, Massachusetts. Fig. 5.—A portion of a pinnule enlarged, showing the common type of the venation. Fig. 6.—A cluster of sporangia, magnified. Fig. 7.—A spore.









#### PLATE XXIX. - Figs. 1, 2.

#### OSMUNDA CLAYTONIANA, LINNÆUS.

## Clayton's Flowering-Fern.

OSMUNDA CLAYTONIANA: - Root-stock creeping, massive with imbricated stalk-bases; stalks erect, several inches to two feet high, rounded on the back, less convex in front, clothed with loose brownish wool when young, never chaffy; fronds two to three feet long, standing in a crown, oblong-lanceolate in outline, somewhat narrowed towards the base, and rounded or short-pointed at the apex, the sterile ones curving gracefully outwards, pinnate with numerous oblong-lanceolate rather obtuse deeply pinnatifid pinnæ; segments ovate-oblong, oblique, entire or obscurely crenulate towards the rounded apex; veins free, usually once forked near the midvein; fertile fronds taller than the sterile, and more erect; the pinnæ mostly similar, but a few (two to four) pairs of those near the middle of the frond contracted, bipinnate, the slender divisions destitute of green tissue, and covered with dark-greenish bivalvular sporangia having a reticulated surface.

Osmunda Claytoniana, Linnæus, Sp. Pl., p. 1521. — Swartz, Syn. Fil., p. 160. — Willdenow, Sp. Pl., v., p. 96. — Pursh, Fl. Am. Sept., ii., p. 657. — Torrey, Fl. N. Y., ii., p. 503. — Presl, Suppl., p. 68. — Gray, Manual, ed. i., p. 634, etc. — Eaton, in Chapman's Fl.,

p. 598. — Hooker & Baker, Syn. Fil., p. 426. — Milde, Monogr. Gen. Osmundæ, p. 101, t. iii., f. 77–85, t. iv. — Williamson, Ferns of Kentucky, p. 135, t. liii.

Osmunda interrupta, Міснаих, Fl. Bor. Am., ii., p. 273. — Swartz, Syn. Fil., p. 160. — Schkuhr, Krypt. Gew., p. 146, t. 144. — Willdenow, Sp. Pl., v., p. 96. — Pursii, Fl. Am. Sept., ii., p. 657. — Ноокег, Fl. Bor. Am., ii., p. 265. — Link, Fil. Hort. Berol., p. 21. — Presl, Suppl., p. 67.

Osmunda basilaris, Sprengel, Anleit., p. 160; Engl. version, p. 175.

Osmunda monticola & O. pilosa, Wallich, "Catal., No. 52." — Presl,
Suppl., pp. 68, 69.

Struthiopteris Claytoniana, Bernhardi, "in Schraders Jour. f. d. Bot. (1800), ii., p. 126."

Plenasium Claytonianum, P. interruptum & P. pilosum, PRESL, "in Abhdl. Böhm. Ges. Wiss., v. (1848), pp. 325, 326."

HAB.—Low grounds and wet thickets, especially in alluvial soil; common from Newfoundland to Lake Superior, and extending southward to the mountainous regions of Arkansas, Kentucky, and North Carolina, and probably somewhat farther. Bourgeau collected it near Sturgeon Lake, some hundred miles north-west of Lake Superior; and Milde gives Lake Winnipeg as a station for it. It is found also in the Himalayan provinces of India; and has been attributed to Brazil, near Rio Janeiro, though probably by an error of Wallich's.

Description. — Clayton's Osmunda has a massive rootstock very similar to that of the royal fern, and densely covered

<sup>&</sup>lt;sup>1</sup> O. glaucescens of Link is referred to O. Claytoniana by Hooker & Baker; but the character given it by Link points plainly to a common American form of O. regalis. But the confusion of synonymy originated with Link himself.

with similar imbricated winged stalk-bases. In cutting across a heavy rhizome of the plant now under consideration, the section being made nearly three inches back of the growing end, the true rhizome was found very much below the centre of the whole mass, so that it was comparatively close to the exterior on the lower side. The rhizome itself is about three lines in diameter, and roundish, but with a fluted exterior. The outer layer is a very dense stratum of hard black sclerenchyma, through which the whitish fibro-vascular systems of stalk-bases pass in a direction but slightly oblique to the central axis of the rhizome. Some of these systems may be seen scarcely separated from the roundish central mass of ducts and cellular tissue of the rhizome; others embedded in its sclerenchyma; and others again just separated from the sclerenchyma of the rhizome, and coated with their own similar hard tissue. These stalk-bases also show the beginning of the whitish stipular wings. Outside of these may be seen older and older stalkbases, some of them cut where the wings are well developed, but many of the outer layers of them going to decay, and their wings completely gone, or reduced to a few disintegrated fibres.

The plant, when it grows in a favorable situation, forms a crown of fronds several feet in diameter. The outer fronds, which are generally sterile, rise nearly erect on their stalks, but gradually bend away from the common centre, and curve outwards in all directions. The fertile fronds are usually the tallest, and stand close together, nearly erect, in the centre of

the crown. The fertile pinnæ are somewhere near the middle of the fronds, most frequently rather above the middle. Above these fertile pinnæ the sterile pinnæ again appear; and this upper part of the fertile frond is more or less curved outward, like the sterile fronds. But this distinction in the bearing of the sterile and the fertile fronds is not always so evident, especially in plants of moderate growth. When the fronds first rise from the ground, they are covered with a light-brown coating of entangled webby fibres. These are shed during the early summer, and the fronds with their stalks become nearly smooth, a little of the wool clinging in the axils of the pinnæ and along the midribs or the veins.

The stalks are greenish in color, and have the back rounded, and the front slightly convex near the base, but considerably furrowed in its upper portion. The transverse section shows a single horseshoe-shaped fibro-vascular bundle, its edges considerably rolled inward. The length of the stalks is from a few inches to nearly or quite two feet. The sterile frond in large plants is fully three feet long, perhaps sometimes longer. A frond three feet long is a foot wide in the middle, and decreases moderately from near the middle to the base; so that the lowest pinnæ are scarcely half as long as the middle ones. Six or eight inches from the end the frond begins to narrow, and narrows so rapidly that the apex is barely acute, and very often somewhat rounded. In the frond here described the lowest pinnæ are nearly opposite, but the successive ones more and more decidedly alternate. The pin-

næ number twenty-three on each side; the lower ones separated by intervals of two and a half inches, and the rest gradually more approximated.

The pinnæ are short-stalked, and in shape are lanceolate from a broad base; the largest ones measured being seven inches long, and one and a quarter inches wide at the base. They are pinnatifid about four-fifths of the depth to the midrib, the segments being eighteen or twenty on each side, closeplaced, oblique, oblong-ovate, and rounded at the ends; the apex of the pinna being barely acute, but never acuminate. In each segment there are about eleven to thirteen veins on each side, the lowest one being on the inferior side of the midvein, and not unfrequently leaving the midrib of the pinna at a point just below the separation of the midvein from the midrib. These veins are almost always forked but once, the forking very near the midvein, and the two veinlets running nearly straight in an oblique direction to the margin of the segment, which is commonly entire, or at most obscurely crenulate towards the apex. In fronds of less ample dimensions the pinnæ are of course fewer and smaller, and the segments also smaller in due proportion.

The lower and the upper pinnæ of the fertile fronds are precisely like those of the sterile fronds. The fertile pinnæ vary in number from one to four pairs, and in position from near the bottom to near the top of the frond. In one frond, of twenty-six pinnæ on each side, the third, fourth, fifth, and sixth on each side are fertile, leaving twenty sterile pinnæ

above them on each side. In another example there are five sterile pinnæ on each side below the fertile ones, and twelve above them. In one frond the third pinna on one side is sterile; while its mate is sterile at the base, but fertile in the upper part. Another frond has one and a half pairs of pinnæ fertile; and still another, four and a half pairs fertile. The fertile pinnæ are as large as the sterile ones in a half-grown frond, and, like them, rise obliquely from the rachis; but in a matured frond they are but one-third to one-fourth as long as the sterile ones, and, when fully ripe, are deflexed. They are closely bipinnate, somewhat woolly with brownish contorted hairs, and densely covered with bivalvular reticulated sporangia, much like those of O. regalis, but of a different and very characteristic color, being blackish-green, and at length dark brown.<sup>1</sup> The spores are trihedric-spheroid, with three radiating vittæ and a granulose surface.

¹ "We notice at once in the sporangia the dark, almost black color, which is in the highest degree characteristic of this species. The ring is 3-4 cells high, and IO-II cells broad. From the top of the sporangium there extend to the line of fissure six small rows of cells, suddenly contracting into from two to four, which form the borders of the fissure. These bordering cells are always bright-colored, not longer than the adjoining cells, but full three times as slender. To the right and left of the ring, and particularly from the upper portion of it, there extend around to the front of the sporangium the blackish-brown cells from which it derives its dark appearance; whilst the cells lying directly beneath the ring, and extending to the pedicel, are bright-brown or yellowish-brown. The whole cell is pervaded by this dark color, and not merely the cell walls, which are not specially thicker than in the other species of Osmunda." — MILDE: Monogr. Osm., p. 107.

This fern was originally described by Linnæus in these words: "Osmunda frondibus pinnatis: pinnis pinnatifidis apice coarctato-fructicantibus." Swartz uses nearly the same character, merely adding after "pinnatis" the words "ferrugineo-tomentosis," and putting a comma before "apice." Willdenow varies the expression a little, but admits that he had seen only imperfect specimens; meanwhile describing the same species well enough under a new name (O. interrupta), which was adopted by nearly all American botanists, until Dr. Gray, examining Clayton's specimens in 1839, ascertained that the O. Claytoniana of Linnæus and the O. interrupta of Willdenow were one and the same species, but that Clayton's specimens were immature, and might readily be supposed to have terminal fructification. This observation I have since been able to repeat, and am perfectly satisfied of its correctness. But Wallich has named a plant from Kumaon Osmunda vestita, which Milde says is a form of the present species with truly terminal fructification. The only Himalayan specimens of O. Claytoniana which I have seen have, however, the submedial fructification of the ordinary form.

Concerning the southern limits of this fern in our country there is still some doubt. Mr. Curtiss sent it from Virginia; Mr. Williamson, in his "Ferns of Kentucky," says it "is found in all our damp, rich woods, but is not so common about Louisville as the O. regalis;" Milde refers to specimens collected by Rugel near Asheville, North Carolina; and from North-western Arkansas Professor F. L. Harvey sends

a sterile frond, probably of this species, but with the pinnæ almost acute enough for the next. I have no note of its occurrence in Tennessee or any of the Gulf States.

Plate XXIX., Figs. 1, 2.—An entire plant, from Mr. Robinson's garden, in Salem, Massachusetts, reduced to about one-eighth of the natural size, showing the massive root-stock, and the fertile fronds rising nearly erect above the recurving sterile ones. Fig. 2 represents a sterile and a fertile pinna of the natural size.

# PLATE XXIX. — Figs. 3-5. OSMUNDA CINNAMOMEA, LINNÆUS.

#### Cinnamon-Fern.

OSMUNDA CINNAMOMEA: — Root-stock creeping, massive with imbricated stalk-bases; stalks a few inches to two feet high, rounded at the back, nearly flat in front, clothed at first with abundant light-brown wool, never chaffy; fronds from a foot to three or four feet long, standing in a crown; the sterile ones oblong-lanceolate in outline, slightly narrowed towards the base, pointed at the apex or even acuminate, pinnate with numerous oblong-lanceolate acute deeply pinnatifid pinnæ; segments ovate-oblong, oblique, usually entire, rounded at the apex, or moderately acute; veins free, usually once forked near the midvein; fertile fronds often as tall as the sterile, produced before them, but withering much sooner; all the pinnæ contracted, bipinnate, destitute of green tissue; the slender divisions covered with cinnamon-brown bivalvular reticulated sporangia.

Osmunda cinnamomea, Linnæus, Sp. Pl., p. 1522. — Swartz, Syn. Fil., p. 160. — Schkuhr, Krypt. Gew., p. 148, t. 146. — Willdenow, Sp. Pl., v., p. 98. — Michaux, Fl. Bor. Am., ii., p. 273. — Pursh, Fl. Am. Sept., ii., p. 657. — Hooker, Fl. Bor. Am., ii., p. 265. — Torrey, Fl. N. Y., ii., p. 503. — Link, Fil. Hort.

Berol., p. 21. — Presl, Suppl., p. 68. — Gray, Manual, ed. i., p. 635, etc. — Mettenius, Fil. Hort. Lips., p. 116; "Prod. Fl. Nov.-Gran., p. 79." — Maximowicz, Prim. Fl. Amur., p. 336. — Hooker & Baker, Syn. Fil., p. 426. — Miquel, Prolus. Fl. Japon. in Ann. Mus. Bot. Lugd.-Batav., iii., p. 182. — Milde, Monogr. Gen. Osmundæ, p. 93, t. v. — Fournier, Pl. Mex. Crypt., p. 140.

Struthiopteris cinnamomea, Bernhardi, "in Schraders Jour. f. d. Bot. (1800), ii., p. 126."

Osmundastrum cinnamomeum, PRESL, "in Abh. Böhm. Ges. Wiss., v. (1848), p. 326."

Osmunda alata, Hooker, "in Edinb. Phil. Jour. (1822), vi., p. 333."

Osmunda Claytoniana, Conrad, "in Jour. Ac. Sc. Philad. (1829), vi., part i., p. 29, t. ii.;" not of Linnæus.

Osmunda imbricata, Kunze, Die Farrnkraüter, ii., p. 29, t. cxii.

HAB.—Low grounds and moist copses; very abundant from Newfoundland to Wisconsin, and southward to Florida and Louisiana. It occurs also in Bermuda, Cuba, and San Domingo, from Mexico to New Grenada, Venezuela, and Brazil, and has been collected in Mantchooria and Japan.

Description. — The cinnamon-fern is in many respects so like the two species of *Osmunda* already described, that a full description of its root-stock, and the stalk-bases with their wings, is unnecessary. Indeed, the whole plant is so very similar to Clayton's flowering-fern, that in the absence of fructification it is not always easy to distinguish one from the other. When well grown the crown of fronds fully rivals that of the other species, and the sterile fronds have almost exactly the

same shape and dimensions; the most evident difference being, that in O. cinnamomea the apex of the frond is decidedly acute, or even acuminate, and so also is each particular pinna. A frond from the swamps of Hudson County, New Jersey, has a stalk twenty inches long, a few shreds of loose wool still adhering to it. The frond itself is thirty-seven inches long, and has thirty pinnæ on each side, besides a few small lobes which form the apex. The lowest pinnæ are three inches long, and five-eighths of an inch wide at the base. The longest pinnæ, which are rather above the middle of the frond, are seven and a half inches long, and an inch and a quarter wide at the base. The number of segments in these longest pinnæ is about twenty-four on each side. In these very large fronds the stipular wings are more elongated than in smaller plants: I find one frond with the wings three and a half inches long, and, the specimen being dried, beautifully marked with oblique slightly curved lines of blackish sclerenchyma. The margin of the segments is usually entire, or obscurely crenulate; but in plants of large size the lower segments of the pinnæ are not unfrequently much elongated, and again pinnatifid. Sometimes it is only the inferior basal segment which is thus enlarged; sometimes several of the segments will exhibit this character. Fronds exhibiting this character have been gathered in Northern New York by Mrs. Barnes, in Connecticut, and in New Jersey. A plant producing them is cultivated in the Botanic Garden at Cambridge, Massachusetts; and this form is doubtless very common throughout the United States.

The fertile fronds rise from the root-stock in early spring, at first densely woolly with light-brown tomentum, and showing a pretty group of little croziers for each plant; but, when the frond is fairly uncoiled, the abundant sporangia give it the characteristic cinnamon-brown coloring. The sterile fronds soon follow the fertile ones, and, when regularly disposed, form a magnificent green vase, within which stand erect the rich plumes of fructification. Normally the fronds are either wholly sterile, green, and firmly chartaceous, or wholly fertile, soft, and devoid of green tissue; but fronds are not rare in which some of the lower pinnæ are foliaceous, while the greater part of them are fully fertile. Other fronds are mainly sterile, but with the apex wholly or partly transformed into fructification. Such fronds, which are plainly mere accidents, constitute the var. frondosa of Gray's Manual and of Milde's Monograph. This condition, rather than variation, occurs also in specimens from Chiapas, Mexico, collected by Dr. Ghiesbreght. W. H. Leggett found still another anomaly in Peekskill, New York, in which the lower part of the frond is fertile, while the apex is sterile, and the middle part shows a gradual transition from one condition to the other. The fertile fronds are usually as tall as the sterile, though sometimes only half their height, and rarely overtopping them. The pinnæ are about two inches long, and, until they wither, stand nearly erect. They are densely bipinnate, and heavily covered with sporangia, which are thus described by Dr. Milde: "The cinnamonbrown color pervades the whole sporangium: this coloring comes not only from the partition-walls, but from the entire cell-wall; and only the ring, as in all the *Osmundas*, is colored yellow in the strata of its cell-walls. The ring is four cells high, and ten to twelve cells broad. The line of fissure is bordered on each side by two or three slender rows of cells, which are not unfrequently much longer than the neighboring large cells, though always three times as narrow." The spores are yellowish-green, globular, and minutely verrucosepunctate. If the three vittæ which belong to the genus are present, I have failed to discover them.

Besides the imperfectly fruited fertile fronds, of which the var. *frondosa* has been constituted, there are mentioned by fern-writers two other varieties.

Var. *alata* (HOOKER, Fl. Bor. Am., ii., p. 265; MILDE, Monogr., p. 94) has the rachis slightly wing-margined,— a not uncommon character of large fronds.

Var. imbricata (MILDE), which is Kunze's Osmunda imbricata, is said to have the fronds rigid and coriaceous, the pinnæ sub-erect, and the segments imbricated. It is a Brazilian form, of which I have seen no specimens; but Milde thinks it passes gradually into the usual form; and fronds with the segments more or less imbricated are not rare in the United States.

All our native species of *Osmunda* may be easily cultivated in common garden-soil, and, in fact, are very frequently seen in the gardens and door-yards of our New-England towns. But if one will take the pains to prepare for these

magnificent ferns a mixture of swamp-muck and river-alluvion, or fine loam, and will keep them supplied with abundant moisture, he will be rewarded by much finer plants than he would otherwise have. Such a bit of artificial bog will do nicely for the species of *Woodwardia* also, and on the sunny edges of it pitcher-plants and sundews and other interesting bog-plants will be almost sure to thrive.

Plate XXIX., Figs. 3-5.— Osmunda cinnamomea. Fig. 3 is an entire plant from the country near Salem, Massachusetts, reduced to almost one-eighth of the natural size. Fig. 4 is a sterile pinna, and Fig. 5 a fertile pinna, both of the natural size.









#### PLATE XXX.

# ASPIDIUM THELYPTERIS, SWARTZ.

# Marsh Shield-Fern.

ASPIDIUM THELYPTERIS: — Root-stock slender, elongated, creeping, blackish, and nearly naked; stalks scattered, fully as long as the fronds or longer, blackish at the base, at first sparingly chaffy, soon smooth; fronds one to three feet long, membranaceous, oblong-lanceolate, scarcely narrowed at the base, short-pointed, pinnate; pinnæ numerous, short-stalked, spreading or slightly decurved, tapering from a broad base to a rather acute or sometimes acuminate apex, slightly pubescent on the midribs and veins, deeply pinnatifid; segments oblong-ovate, usually entire, obtuse; veins free, the lower ones or all of them forked near the midvein; fertile fronds on longer stalks, and with narrower segments than the sterile ones; sori as near or nearer the midvein than the margin, which is often revolute; indusia minute, reniform, often minutely glandular at the edge.

Aspidium Thelypteris, Swartz, "in Schraders Jour. (1800), ii., p. 40;"

Syn. Fil., p. 50.— Schkuhr, Krypt. Gew., p. 51, t. 52.— Willdenow, Sp. Pl., v., p. 249.— Pursh, Fl. Am. Sept., ii., p. 661.

— Torrey, Fl. N. Y., ii., p. 496.— Gray, Manual, ed. ii., p. 597, etc.— Mettenius, Fil. Hort. Lips., p. 92; Aspidium, p. 112.— Milde, Fil. Eur. & Atl., p. 116.

Acrostichum Thelypteris, LINNÆUS, Sp. Pl., p. 1528.

Polypodium Thelypteris, LINNÆUS, "Mantissa, p. 505."

Polystichum Thelypteris, Roth, "Fl. Germ., iii., p. 77." — Koch, Syn. Fl. Germ., ed. iii., p. 733.

Nephrodium Thelypteris, Desvaux, "in Mém. Soc. Linn., vi., p. 257."— Ноокек, Brit. Ferns, t. 13; Sp. Fil., iv., p. 88.— Ноокек & Вакек, Syn. Fil., p. 271.

Lastrea Thelypteris, Presl, Tent. Pterid., p. 76. — Moore, Nat. Pr. Brit. Ferns, t. xxix.

Dryopteris Thelypteris, GRAY, Manual, ed. i., p. 630.

Thelypteris palustris, Schott, Gen. Fil. (with a plate).

Var. squamigerum. — Midribs bearing a few ovate scales beneath; indusium beset with stalked glands and slender hairs; otherwise as in the type.

Aspidium Thelypteris, β squamigerum, Schlechtendal, Adumbr. Pl., p. 23, t. xi. — Kunze, Pl. Acotyl. Afr. Aust. Recens. Nov., p. 67.

Aspidium squamigerum, Fée, 8me Mém., p. 104.

Nephrodium Thelypteris, β. squamulosum, J. D. Hooker, Handb. of N. Z. Flora, p. 777.

Lustrea Fairbankii, BEDDOME (!), "Fil. Brit. Ind., t. 254."

Hab.—Very common in marshes and wet places, but sometimes in dry ground, from Lake Winnipeg, British America, and New Brunswick, to Louisiana and Florida. Europe, Siberia, Mantchooria, and Himalayan India. The variety occurs in South Africa, New Zealand, and Southern India.

Description.—The root-stock is very slender, nearly black, almost devoid of chaff, and creeps for many inches just beneath the surface of the ground. The stalks are scattered along the

root-stock, the newest portion of which bears a few short stems an inch long or less, which would naturally be developed into fronds the coming year.

The stalks are commonly a little longer than the frond, slender, and naked, except for a few scales which soon disappear. The stalk is roundish on the back, furrowed in front, and contains near the base two oval fibro-vascular bundles, as Milde has observed; but higher up the two are united into one, which is concave anteriorly, and contains three internal vascular projections from the concave side, two of them directed obliquely towards the edges of the bundle, and one pointed towards the middle of the opposite curvature.

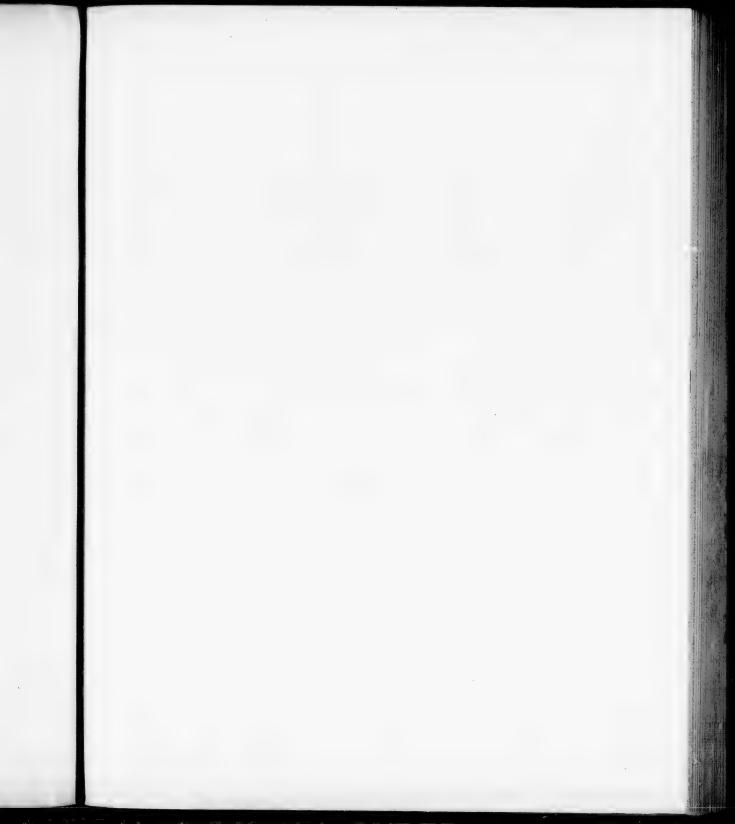
The frond sometimes varies in length from a very few inches to nearly three feet; but commonly it is about a foot long, and four or five inches wide. Such a frond has about twenty to thirty pinnæ on each side, sometimes regularly arranged in pairs to the very apex, but more frequently more or less alternate. The lower two or three pairs are usually but little shorter than those above them; but fronds are occasionally found in which they are conspicuously reduced. One such is figured by Moore, at Plate XXIX. of the Nature-printed British Ferns; and I have similar fronds from various places in America. The texture of the fronds is slightly heavier than in the New York shield-fern, but still membranaceous. The fronds wither at the first frost, and decay during the winter

<sup>&</sup>lt;sup>1</sup> The left-hand figure. The folio edition is always referred to in the present work.

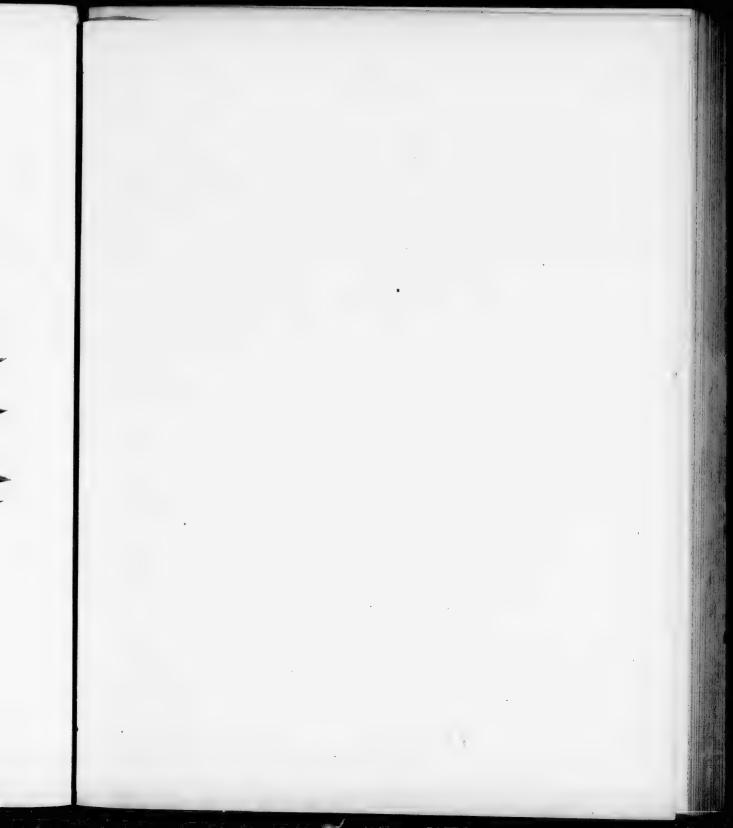
months. The pinnæ are lanceolate, and usually broadest at the base, where they join the rachis by a very short but evident petiole. They taper gradually to the apex, which is acute or even acuminate in most specimens, but is now and then "rather obtuse," as Hooker remarks in his work on the British Ferns. The surface appears smooth; but careful examination reveals a slight pubescence along the midribs and veins, especially on the under surface. The segments are ovateoblong, with mostly entire edges, and a rounded or at most scarcely acute apex; though the apex often seems acute in the fertile fronds, on account of the frequently revolute margins of the segments. The lower segments are rarely enlarged and pinnately toothed, or lobed. The veins are free. Commonly the veins fork near the midvein into two divergent veinlets; but very often only the lower veins are thus forked, and the upper ones are simple, as in A. Noveboracense.

The fruit-dots are of small size, and are placed on the back of the veins, just above the place of forking; or, if the veins are simple, nearer the midvein than the margin. The indusium is minute, reniform, and somewhat glandular on the margin. The spores are oval, and densely muricated.

Plate XXX. — Aspidium Thelypteris. Fig. 1 is a plant from Salem, Massachusetts, with two fronds, one of them fertile. The long creeping root-stock, with several rudimentary fronds rising from it at intervals, is well represented. Figs. 2 and 3, a sterile and a fertile pinna. Fig. 4, an indusium. Fig. 5, a spore. The last two figures only are magnified.







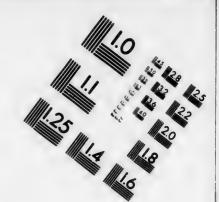
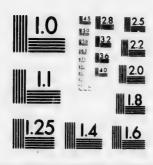


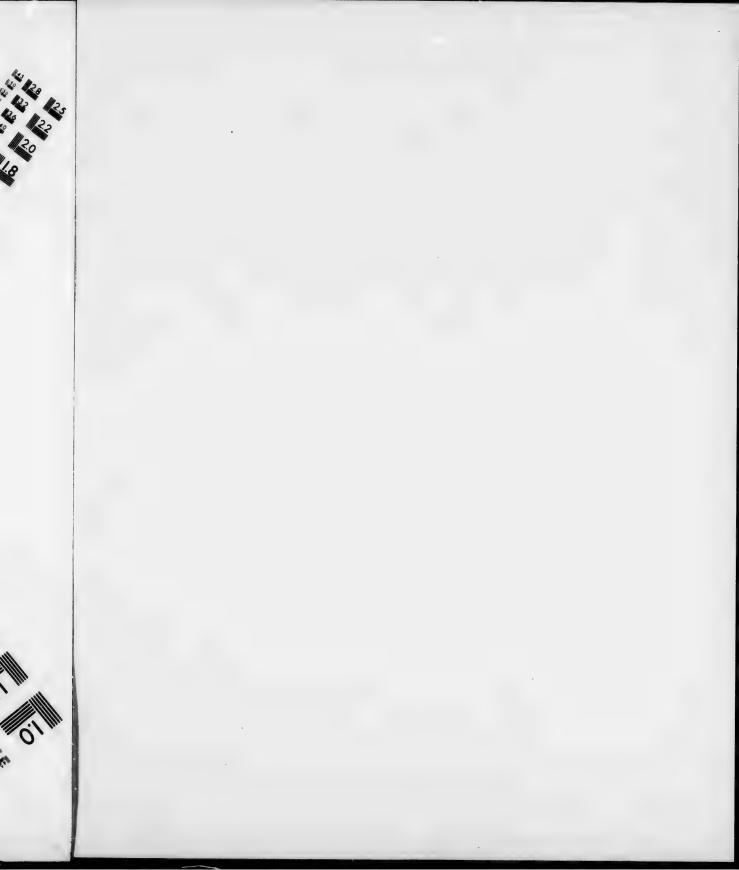
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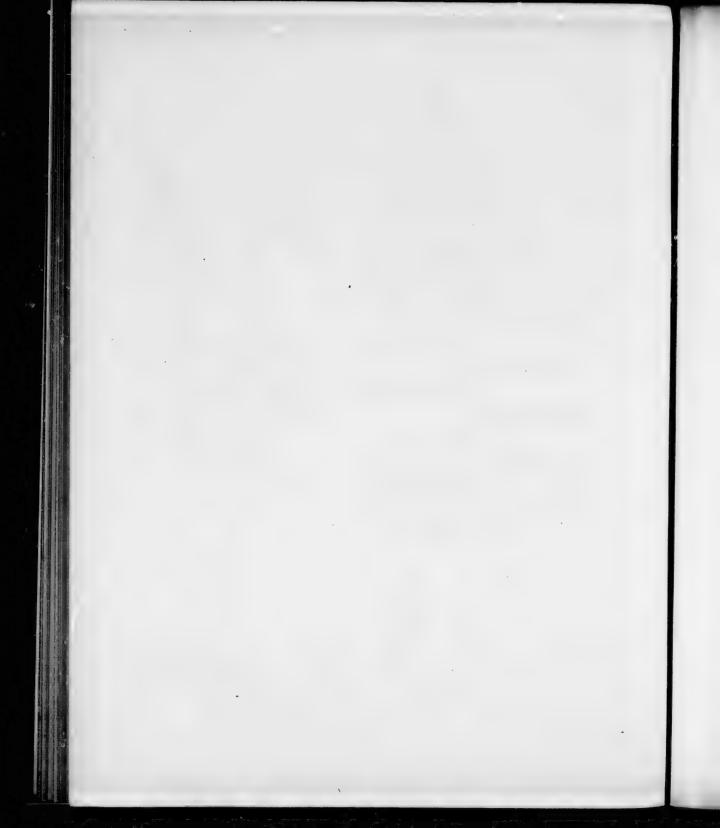


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#### PLATE XXXI. - Figs. 1-3.

# POLYPODIUM VULGARE, LINNÆUS.

# Common Polypody.

POLYPODIUM VULGARE: — Root-stocks chaffy, extensively creeping and entangled; stalks scattered, green and herbaceous, rather slender, naked, two to eight inches long; fronds evergreen, sub-coriaceous, smooth, two to ten inches long, ovate-oblong to oblong-linear, acuminate, pinnatifid almost to the midrib; segments numerous, spreading, linear-oblong, acute or obtuse, the lower ones separated by rounded sinuses, the upper sinuses acute; margins obscurely crenulate-serrate, less commonly serrate, or even incised; veins all free, usually with three or four veinlets, the lowest anterior veinlets bearing at their thickened ends the sub-globose sori midway between the midrib and the margin of the segments.

Polypodium vulgare, Linnæus, Sp. Pl., p. 1544. — Michaux, Fl. Bor. Am., ii., p. 271. — Swartz, Syn. Fil., p. 34. — Schkuhr, Krypt. Gew., p. 12, t. 11. — Willdenow, Sp. Pl., v., p. 172. — Pursh, Fl. Am. Sept., ii., p. 658. — Bigelow, Fl. Bost., ed. iii., p. 417. — Gray, Manual, ed. i., p. 622; ed. ii., p. 590, t. ix. — Moore, Nat. Print. Brit. Ferns, t. i., ii., iii. (excluding a portion of the synowyny). — Koch, Syn. Fl. Germ., ed. iii., p. 730. — Mettenius, Polypodium, p. 61. — Maximowicz, Prim. Fl. Amur., p. 337. — Hooker, Brit. Ferns, t. 2; Sp. Fil., iv., p. 205. — Hooker

& Baker, Syn. Fil., p. 334. — McKen, Ferns of Natal, p. 19. — Milde, Fil. Eur. et Atl., p. 18. — Williamson, Ferns of Kentucky, p. 35, t. iv.

Polypodium vulgare, var. Americanum, Hooker, Fl. Bor. Am., ii., p. 258.

— Torrey, Fl. N. Y., ii., p. 484.

Ctenopteris vulgaris, NEWMAN, Hist. Brit. Ferns, p. 42.

Polypodium Virginianum, Linnæus, Sp. Pl., p. 1545. — Swartz, Syn. Fil., p. 34. — Willdenow, Sp. Pl., v., p. 174. — Pursh, Fl. Am. Sept., ii., p. 658.

Polypodium Cambricum, LINNÆUS, Sp. Pl., p. 1546 (a form with pinnatifid segments).

Polypodium australe, Fée, Gen. Fil., p. 236 (the same as P. Cambricum, but coming from Sardinia, Teneriffe, etc.).

HAB.—On rocks both shaded and sunny, and on banks, less frequently on trunks of trees; a very common and abundant species. The North-American range extends from the Atlantic to the Pacific, and from the Slave River and Winnipeg Valley to the mountains of Colorado, Arkansas, and North Carolina, and probably to those of Alabama also. A form with acute segments (var. occidentale of Hooker) occurs in California, Oregon, and British Columbia; but specimens of the ordinary type have been sent from Unalaska and Vancouver's Island, as well as from the boundary-line of British Columbia and Washington Territory. Throughout Europe and Northern Asia to Kamtschatka and Japan; Azores, Madeira, Barbary States, and Cape Colony. Mexico and the Hawaiian Islands are also mentioned by some authors; but the evidence is not satisfactory.

Description. — The root-stocks are elongated and creeping, attaining a length of several inches, and a diameter of

two or two and a half lines. They are usually branched and more or less entangled, and commonly grow with the upper surface exposed to the air. They are of a firm fleshy consistency when fresh, but become hard and somewhat shrivelled when dry. The color is greenish throughout their substance; but in dried specimens the surface is often white pruinose. Scattered along the root-stock are slightly raised roundish protuberances, with the top slightly concave. These are the scars which mark the position of former fronds, and, as remarked on p. 116, form one of the characteristics of true *Polypodia*. The whole root-stock is covered with ovate-acuminate brownish chaffy scales, peltately attached near the base. The middle portion of the scales, and the slender acumination, are often darker in color than the border, which is irregularly erose-ciliate or denticulated.

The stalks are smooth and slender, and usually a little shorter than the fronds they support. They are brownish at the base, becoming green higher up, and, while tough in texture, are very flexible. At the base they are nearly terete, but have along each side a slightly prominent line, which, as it approaches the frond, becomes more and more evident, and so is gradually developed into a very narrow wing descending from the segments of the frond. The fibro-vascular bundle is solitary in the specimens I have examined; but, in large fronds, Dr. Milde has found two or three.

The frond is evergreen, sub-coriaceous, smooth: in outlinit varies from ovate to oblong-linear, and in length from half

an inch (Colorado plants) to nine inches (New York), or even fourteen inches (Madeira). Similarly its width varies from four lines to nearly six inches. But the usual size of fronds in the Northern States is from six to eight inches long, and two or two and a half wide. The fronds are so deeply pinnatifid that the incisions extend almost to the rachis, and contiguous segments are connected by only the narrowest wing. The segments are usually oblong-linear from a more or less dilated base; the lower ones but little if any shorter than the middle ones, and the upper ones decreasing gradually, and so passing into the incised or serrate and commonly acuminate apex. The lower sinuses are broad and rounded, and the upper ones narrower and more acute. The number of segments in an ordinary frond is from fourteen to eighteen on each side. Some very much dwarfed plants collected by Professor John Wolf at an altitude of eleven thousand feet, near the Twin Lakes of Colorado, have only four or five little roundish-oblong lobes on each side; and, to go to the other extreme, some fine British fronds have as many as twenty-three lobes on each side. The lobes are either obtuse or acute at the apex; and, though the obtuse form is commoner here than in Europe, neither condition is confined to either side of the ocean. The margin of the segments is also variable, being commonly obscurely serrulate, often undulate, coarsely serrate (in specimens from the south of Europe especially), or even again pinnatifid; in which condition it has been found in several countries of Europe, and at least twice in the United States. Fronds

with forked or variously (storted segments are by no means uncommon.

Dr. Milde indicates ten varieties, — commune, attenuatum, rotundatum, angustum, brevipes, auritum, serratum, occidentale, Teneriffee, and Cambricum. The first five differ merely by longer or shorter obtuse or acute fronds and segments; the sixth is an occasional monstrosity; the seventh (serratum of Willdenow) includes the large forms of Southern Europe, etc., having serrated segments; the eighth (occidentale of Hooker) is the plant of the Pacific coast, having acuminate segments; the ninth is a sub-glaucous form from Teneriffe and the Azores; and the last (Cambricum) is an old Linnæan spe-Lific name for a form, first found in Wales, in which the primary segments are much widened, and pinnatifid into numerous very narrow serrulate lobes. This variety is made to include Moore's var. semilacerum, which differs principally in being bipinnatifid only in the lower half, and often fertile; while the original Cambricum is bipinnatifid throughout, and almost always sterile. Var. Cambricum has been found near Stonington, Connecticut, by Miss Kate Stanton of that village, and at Cold Spring, New York, by Miss Sarah P. Monks, at the time a student in Vassar College. Professor Robinson finds in Essex County, Massachusetts, various forms referrible to var. auritum.

The veins are all free, and the veinlets have thickened apices. In the smaller fronds the veins are forked into two nearly equal veinlets, of which the upper one may bear a sorus at its extremity. In somewhat larger plants the lower veinlet of each pair is again forked; and this is, perhaps, the commonest arrangement. In var. occidentale the middle one of the three veinlets is once more forked, as it is also in large fronds from Europe. Var. serratum has as many as five veinlets in each group; and in var. Cambricum the primary veins are elongated, and bear numerous simple or forked secondary veinlets.

The rounded sori are about one line in diameter, and are borne about midway between the midrib and the margins of the segments. The sporangia have the proper vertical incomplete ring of the sub-order. The number of joints in the ring of *Polypodiaceæ* is variable; the extremes, according to Fée, being ten and thirty-two. In the present species I have observed thirteen, fourteen, and fifteen. The spores are rather large, yellowish, and oblong-reniform: they have a single vitta or band along the concave side, and the surface is minutely areolated or reticulated.

The young fronds appear in the spring, and by August or September are in full fruit. They remain green through the winter, the emptied sporangia still clinging to them till after the new fronds are developed in the succeeding season.

Plate XXXI., Figs. 1-3. — Polypodium vulgare. Fig. 1 is a plant from Beverly, Massachusetts, of the common form in New England; Fig. 2, a sporangium; Fig. 3, a spore. The last two are more or less magnified.

### PLATE XXXI. - Figs. 4, 5.

# POLYPODIUM CALIFORNICUM, KAULFUSS.

Californian Polypody.

Polypodium Californicum:— Root-stock creeping, chaffy with light-brown scales; stalks greenish, straw-colored when dry, smooth; fronds from a few inches to a foot long, ovate or ovate-oblong, papery-herbaceous, or, if grown near the sea, of firmer texture, pinnatifid almost to the midrib; segments numerous, oblong-linear, obtuse or acute, the lower ones mostly opposite, narrowed at the lower side of the base, and separated by rounded sinuses, the upper ones opposite or alternate, dilated at the base, especially on the upper side, and with narrower sinuses; margins obscurely or plainly serrate; veins producing four to six veinlets, and often forming oblique areolations; sori slightly elliptical, rather remote from the margin.

Polypodium Californicum, Kauleuss, Enum. Fil., p. 102. — Hooker & Arnott, Bot. Beechey's Voy., pp. 161, 405. — Torrey, Pacif. R. Rep., iv., p. 159. — Eaton, in Bot. Mex. Boundary, p. 235. — Hooker, Sp. Fil., v., p. 18. — Hooker & Baker, Syn. Fil., p. 341. — [Not P. Californicum of Mettenius, Pol., p. 71.]

Polypodium intermedium. Hooker & Arnott Bot Beechey's Voy. p. 407.

Polypodium intermedium, Hooker & Arnott, Bot. Beechey's Voy., p. 405.
— Hooker, Fl. Bor.-Am., ii., p. 258.— Torrey, Pacif. R. Rep., iv., p. 159.— Вкаскентоде. Fil. of U.S. Expl. Exped., p. 9.

Marginaria Californica, PRESL, Tent. Pterid., p. 188.

Two principal forms occur: -

Var. Kaulfussii. — Frond firm-chartaceous; segments narrowly oblong-linear; veinlets regularly forming a single series of narrow oblique areoles.

Var. intermedium. — Frond herbaceous or membranaceous; segments broadly oblong-linear; veinlets forming only scattered areoles.

HAB. — California, apparently confined to the region west of the Coast Range of mountains, and to the islands lying off the shore. Var. Kaulfussii has been collected at San Diego, at San Luis Obispo, near San Francisco, on Guadalupe Island, etc., usually on rocks near the sea. Var. intermedium, on shaded rocks on islands in the Bay of San Francisco, on Monte Diablo, at San Diego, in Marin and Mendocino Counties, and in other places in the same general region.

DESCRIPTION.—The root-stock is creeping, with the upper side exposed to the air, as in *P. vulgare*, and is chaffy with very similar scales. The stalks are not quite so slender as in the other species, and contain three or four fibro-vascular bundles. In the living plant the stalks are probably green and flexible; but in the dried specimens they are straw-color.

The largest fronds I have seen are a foot long, and five and a half inches wide; but more commonly the fronds are six or eight inches long, and about three inches broad. The texture of fronds from inland localities is rather thinner than in *P. vulgare*, and the veins are more easily seen; but plants from the seacoast, which are evidently similar to those de-

scribed by Kaulfuss,1 have a firmer frond, and less conspicuous veins. The fronds are commonly ovate in outline, though occasionally somewhat narrower, and then ovate-oblong. The segments number from thirteen to sixteen on a side in fronds of average size. The lower ones are much more frequently opposite than in P. vulgare, and are generally somewhat narrowed at the base, leaving broad open sinuses between them. Towards the apex of the frond the segments are alternate, and are so closely placed as to leave only narrow and very acute sinuses. The segments are oblong-linear, either obtuse or acute, and have the margin serrated, sometimes obscurely so, and at other times sharply serrate, or even almost incised. The veins are branched much as in the last species, but have rather more numerous veinlets. In var. intermedium the veinlets form an areole only here and there; but in var. Kaulfussii, which runs by gradations into the inland form, there is a regular series of areoles each side of the midrib.

The sori are rather nearer the midrib than the margin, placed on the thickened termination of the superior basal veinlet of each group, and, when well preserved, are almost invariably oval in shape. The number of joints in the ring is

<sup>&</sup>lt;sup>1</sup> The original character given by Kaulfuss reads thus, when translated: "Polypodium with deeply pinnatifid fronds, the segments oblong, retuse, sharply serrate, the lower ones narrowed at the base, and decurrent; veins oblique, parallel, veinlets forking and anastomosing; sori ovate, solitary.

<sup>&</sup>quot;HAB. - In California. Chamisso.

<sup>&</sup>quot;Similar to *Polypodium vulgare*, but very distinct; the veinlets anastomosing near the margin of the segment, and enclosing an ovate fruit-dot."

pretty uniformly twelve. The spores are yellowish, oblongreniform with flattish sides, which meet at the concave side, and there form a thin and very narrow wing. The surface of the spore is covered with very minute slightly-elevated roundish areolations, like the rind of an orange on a greatly-reduced scale.

While in var. intermedium this species makes an inconveniently near approach to *P. vulgare*, in var. Kaulfussii it shows quite as close an affinity to several species of the section Goniophlebium, especially to *P. Catharinæ* of Langsdorff & Fischer (Ic. Fil., p. o, t. o).

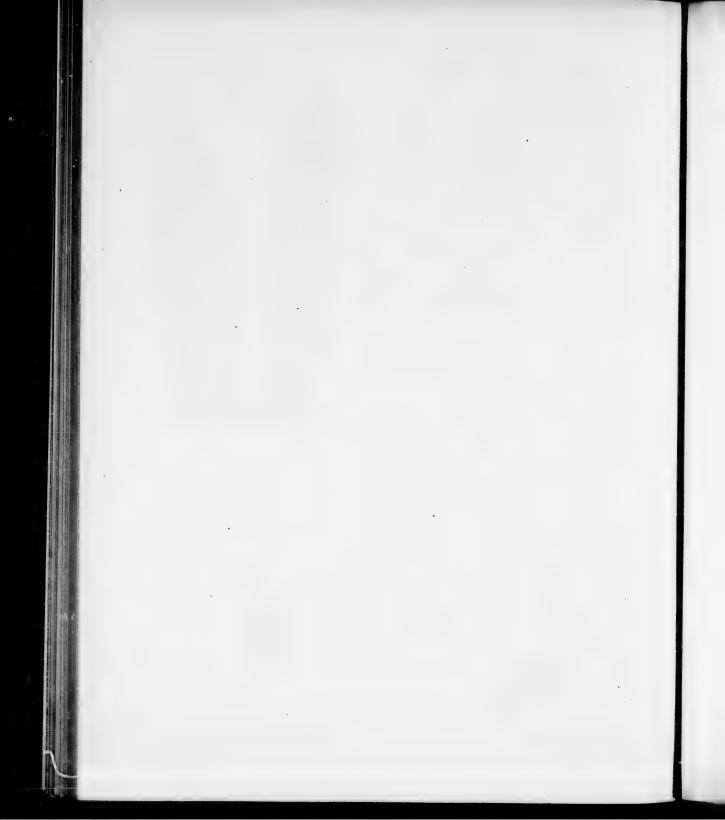
It may be noticed in this connection that Milde says of the veinlets of *P. vulgare*, var. serratum, "Interdum ramos anastomosantes inveni."

Plate XXXI., Figs. 4, 5.— Polypodium Californicum. The frond selected for drawing was collected at San Diego by Mr. D. Cleveland, and represents the var. intermedium. Fig. 5 is a portion of a segment slightly enlarged, and shows the irregular character of the venation.









#### PLATE XXXII. - Figs. 1, 2.

### SCOLOPENDRIUM VULGARE, SMITH.

#### Hart's-Tongue.

Scolopendrium vulgare: "Root-stock short, erect or inclined, chaffy as are the short tufted stalks; fronds simple, half a foot to a foot and a half long, one to two inches wide, oblong-ligulate from a deeply cordate and somewhat auricled base; veins forked usually twice, veinlets free; involucres elongated, placed face to face in pairs on contiguous veinlets.

Scolopendrium vulgare, Smith, in Mém. Acad. Turin, v., p. 421, t. 9, fig. 2.—Moore, Nat. Pr. Brit. Ferns, t. xlii.— Hooker, Brit. Ferns, t. 37.—Grav, Manual, ed. v., p. 662, t. 17.—Hooker & Baker, Syn. Fil., p. 246.—Milde, Fil. Eur. et A. 1t., p. 89.—Lawson, in Canad. Nat., i. (1864), p. 278.

Scolopendrium officinarum, Swartz, in "Schraders Jour. (1800), ii., p. 61;"

Syn. Fil., p. 89.— Schkuhr, Krypt. Gew., p. 78, t. 83.— Pursh,
Fl. Am. Sept., ii., p. 667.— Torrey, Fl. New York, ii., p. 490.

— Gray, Manual, ed. i., p. 626, etc.— J. A. Paine, in Silliman's Journ., Sept. 1866, p. 281.

Asplenium S slopendrium, LINNÆUS, Sp. Pl., p. 1537. — PUPSH, Journal of a Botan. Excursion, p. 64.

HAB.—In the crevices of broken lime-rock, in deep ravines; Onondaga and Madison Counties, New York, and Owen Sound, Ontario, Canada; Chiapas, in Mexico; Europe, from the British Islands to the Caucasus; also in Syria. Turkestan, Japan, Algiers, Madeira, and the Azores. For a full discussion of the American stations, see the article by Professor Paine above referred to, and compare with Pursh's Journal.

DESCRIPTION. — The hart's-tongue, though among the rarest of American ferns, is a common plant in Europe. It has a short root-stock, with adherent clustered stalks, which are very chaffy, with narrow light-brown scales. The stalks are only a few inches long, nearly terete, and contain a single fibrovascular bundle, which has three little bands of sclerenchyma on its exterior surface. The texture of the living frond is sub-coriaceous; but it becomes more chartaceous in drying. The undivided and tongue-like frond is usually undulate on the margin, and may be either obtuse or acute at the apex. Rarely the basal auricles are wanting. The sori are made up of two Asplenioid sori facing each other on adjacent veinlets. Moore describes sixty-six variations of form, some of them exceedingly strange and abnormal. The genus, strictly limited, contains three other species; but Hooker extends it so as to include Antigramme, Camptosorus, and Schaffneria.

The specimen drawn is smaller than the average, and was collected at DeWitt, Onondaga County, New York, by Mr. L. M. Underwood.

### PLATE XXXII. - Figs. 3-5.

# LOMARIA SPICANT, DESVAUX.

## Hard-Fern or Deer-Fern.

Lomaria Spicant: — Root-stock short and thick, very chaffy; fronds tufted, erect, smooth, sterile ones nearly sessile, or short-stalked, sub-coriaceous, narrowly linear-lanceolate, six to thirty inches long, one to three inches wide, tapering from above the middle to both ends, pinnatifid to the rachis into very numerous close-set oblong or oblong-linear often upwardly curved obtuse or apiculate segments, the lower ones gradually diminished to minute auricles; fertile fronds taller than the sterile, long-stalked, pinnate; the pinnæ less crowded, longer and much narrower than the sterile segments, sessile by a suddenly dilated base; involucres just within the margin; mature sporangia nearly covering the back of the pinnæ.

Lomaria Spicant, Desvaux, in Mag. d. Gesellsch. Naturforsch. Freunde zu Berlin, v. (1811), p. 325. — Presl, Tent. Pterid., p. 142. — Ruprecht, Dist. Crypt. Vasc. in Imp. Ross., p. 45. — Brackenridge, Fil. U. S. Expl. Exped., p. 123. — Hooker, Sp. Fil., iii., p. 14. — Hooker & Baker, Syn. Fil., p. 178.

Lomaria borealis, Link, "Hort. Berol., ii., p. 80;" Fil. Hort. Berol., p. 75.

Osmunda Spicant, LINNÆUS, Sp. Pl., p. 1522.

Onoclea Spicant, Hoffmann, "Deutschlands Flora, ii., p. 11."

Blechnum Spicant, Smith, in Mém. Acad. Turin, v., p. 411.— NEWMAN, Hist. Brit. Ferns, p. 17.— Moore, Nat. Pr. Brit. Ferns, t. xliii.— Milde, in Nov. Act. Acad. Nat. Cur., xxvi., ii., p. 612; Fil. Eur. et Atlant., p. 46.

Blechnum borcale, Swartz, "in Schraders Journal, ii. (1800), p. 75;"

Syn. Fil., p. 115.—Schkuhr, Krypt. Gew., p. 102, t. 110.—

Willdenow, Sp. Pl., v., p. 408.—Hooker, Brit. Ferns, t. 40.

Stegania borealis, R. Brown, Prodr. Fl. Nov.-Holl., p. 152.

Spicanta borealis, PRESL, Epim. Bot., p. 114. (For other synonymy, see Willdenow and Moore in the works above referred to.)

HAB.—On the ground in dense forests, and sometimes in open places, from Mendocino County, California, to Oregon, Pritish Columbia, and Sitka; Europe, from the extreme North to the .slands of the Mediterranean and Madeira; also in the Caucasus, Kamtschatka, and Japan.

DESCRIPTION. — The root-stock is short and thick, erect or inclined, covered with imbricating stalk-bases, and very chaffy. The stalks are numerous, and clustered at the end of the root-stock. They are chaffy at the base, with very rigid, nearly entire, lanceolate-acuminate dark-brown scales, often provided with a still darker and denser midrib.

The fronds are dimorphous, the fertile ones being very unlike the sterile. The sterile fronds have a stalk from one to eight inches long; and the fronds themselves are from six to thirty inches long, narrowly lanceolate in outline, and taper both ways from just above the middle, the lower segments being gradually shorter and shorter to the base, where they appear like little disconnected wings along the sides of the

midrib. The middle segments, or pinnæ (for they are fairly distinct from each other), are closely placed, six to eighteen lines long, oblong or oblong-linear from a slightly dilated base, and usually curved upwards. Their margin is either entire, or obscurely crenulate towards the apex, which is oftenest obtuse. In a small frond there are from twenty-four to thirty segments on each side, while on a very large frond from California as many as seventy-eight segments may be counted on each side. The sterile fronds are sub-coriaceous in texture, and more rigid than most ferns; whence the name of "hard-fern." The veins fork once near the midrib; and the tips of the free veinlets, just within the margin of the segment, are slightly swollen, and often marked by depressed dots on the upper surface.

The fertile fronds are fewer in number than the sterile, and stand much higher, having stalks many times longer than the others. Like the sterile fronds, they are narrowly lanceolate in outline; but the pinnæ are very much narrower, and often a little longer. The veins are simple, and unite so as to form a series of rhomboid-oblong areoles along each side of the midvein, and very rarely are produced beyond the outer boundary of these areoles. Nearly, but not always exactly, coincident with this outer side of the areoles, is a continuous vein-like receptacle, which bears the sporangia, and is produced, outside of them, into a very delicate continuous involucre, the free edge of which is turned towards the midvein. When the sporangia are mature the involucres are thrown back, and the fruit seems to cover the whole under surface of the pinnæ. The

green tissue of the frond is sometimes evidently continued outside the receptacle, and then the character is rather that of *Blechnum* than of *Lomaria*; and, indeed, the species has about an equal right in both genera, and, in consequence, has always been a puzzle to systematists. The sporangia have a ring of nineteen or twenty articulations; and the spores are roundish-ovoid, with a minutely roughened surface.

The magnificent plants of the Pacific coast were named var. elongata by Sir W. J. Hooker in the Species Filicum, but seem to pass by gradations into the smaller and more condensed form commonly seen in Europe. This European form was collected near Astoria in Oregon by Professor Wood, who says it is common there, and that it is called "deer-fern" by the inhabitants. Another form is one in which the fertile pinnæ are wider, and the veins are produced considerably beyond the fructification, and the latter is broken into short sori, as in Doodya. This is Hooker's Blechnum doodioides, a name founded on two fronds from British Columbia. Milde reports similar plants from Silesia and Madeira, and suggests that perhaps they represent B. denticulatum of Swartz, a plant not otherwise recognizable.

PLATE XXXII., Figs. 3-5.—Lomaria Spicant. Fig. 3 is a plant from Crescent City, California, reduced to one-half the natural size; Fig. 4, a sterile segment, slightly enlarged; Fig. 5, a part of a fertile segment, also enlarged, showing the arcoles and the receptacle, the latter not exactly coincident with the outer veinlet of the arcoles.









#### PLATE XXXIII.

# BOTRYCHIUM VIRGINIANUM, SWARTZ.

### Virginian Grape-Fern.

BOTRYCHIUM VIRGINIANUM:—Plant sparsely hairy, usually from eight inches to two feet high; sterile segment membranaceous, sessile near the middle of the plant, broadly deltoid, ternate; the primary divisions stalked, once to three times pinnatifid; secondary divisions ovate-lanceolate, ultimate divisions toothed at the ends; fertile segment long-stalked, twice to four times pinnate; base of stalk opening by a longitudinal chink, and disclosing the pilose bud.

Botrychium Virginianum, Swartz, in Schraders Journal, ii. (1800), p. 111; Syn. Fil., p. 171. — Schkuhr, Krypt. Gew., p. 157, t. 156. — Ruprecht, Dist. Crypt. Vasc., in Imp. Ross., p. 33. — Milde, Fil. Eur. et Atl., p. 207; Botry. Monogr., p. 177. — Miquel, Prolus. Fl. Jap., in Ann. Mus. Bot. Lugd.-Bat., iii., p. 182. — Ноокег & Вакег, Syn. Fil., p. 448, excl. B. lanuginosum. — Davenport, in Bull. Torr. Club, vi., p. 197. — Williamson, Ferns of Kentucky, p. 141, t. lvi.

Botrychium Virginicum, WILLDENOW, Sp. Pl., v., p. 64. — PURSH, Fl. Am. Sept., ii., p. 656. — Wahlenberg, "Fl. Suec., ii., iii., p. 681." — Torrey, Fl. New York, ii., p. 506. — Presl, Suppl., p. 46. — Gray, Manual, ed. i., p. 635, etc. — Brackenridge, Fil. U. S. Expl. Exped., p. 317. — Lawson, in Canad. Nat. (1864), p. 292. — Fournier, Pl. Mex. Crypt., p. 140.

Botrychium anthemoides, PRESL, "in Abh. Böhm. Gesellsch. Wissensch., v. (1848), p. 323."

Osmunda Virginiana, LINNÆUS, Sp. Pl., p. 1519.

Osmunda fronde pinnatifida caulina, fructificationibus spicatis, Gronovius, Fl. Virg., p. 196.

The following varieties are described in Milde's "Botrychiorum Monographia:"—

Var. gracile.— "Smaller and more delicate; ultimate divisions narrow, sub-lineal, sharply toothed; panicle with few capsules."—*Botrychium gracile*, Pursh, Fl. Am. Sept., ii., p. 656.

Var. Mexicanum, Hooker, "Bot. Misc., iii., p. 223."—"Delicate, primary segments more acuminate; secondary ones pinnately parted, oblong, acute, ultimate divisions deeply incised-toothed; the teeth seldom more than six, acute; panicle usually much shorter than the sterile segment."—Botrychium brachystachys, Kunze, in Linnæa, xviii., p. 305.

Var. cicutarium. — Tall, sterile segment, three or four times pinnately parted; fruiting-stalk rising far below the base of the sterile segment, and the latter, therefore, long-stalked; panicle mostly shorter than the sterile segment. — Botrychium cicutarium, SWARTZ, Syn. Fil., p. 172. — WILLDENOW, Sp. Pl., v., p. 65. — Osmunda cicutaria, LAMARCK, "Enc. Bot., iv., p. 650." — Osmunda asphodeli radice, Plumier, Fil. Am, p. 136, t. 159.

HAB.—In rich woods; from New Brunswick and Canada to Washington Territory and Oregon, and southward to Colorado, Texas, Alabama, and Florida; also in Mexico, Hayti, New Granada, Venezuela, Ecuador, and Brazil, Northern Europe, Siberia, and Japan.

DESCRIPTION. — The Virginian grape-fern, or rattlesnake-fern as it is as commonly called, is usually our largest species

of this interesting but troublesome genus. It differs from all the other species in several more or less important characters; so that Dr. Milde, in his last classification of the genus, placed it in a separate sub-genus, to which he gave the name of Osmundopteris.¹ The root-stock is very short, but the roots long and fleshy. The base of the stalk is slightly swollen, and is provided with a longitudinal fissure, within which the bud may be easily seen. The bud itself is decidedly hairy, and, as Mr. Davenport has shown, has the "fertile frond recurved its whole length, with the longer sterile frond reclined upon it." It will be remembered that in the other Botrychia the stalk-base completely encloses the bud.

The common stalk in a large plant is often twelve or fourteen inches long, and the stalk of the panicle as much more; so that the sterile segment, or lamina as Dr. Milde calls it, is placed very near the middle of the whole. The sterile lamina is broadly triangular; so broad, that the width is usually greater than the length. One fine specimen from New Brunswick has the sterile part a foot broad, and eight inches long; and equally large plants are by no means rare. In North America the sterile part is closely sessile; but in the West-Indian form, as represented in Plumier's figure, it has a petiole over two inches long. The lower primary divisions are

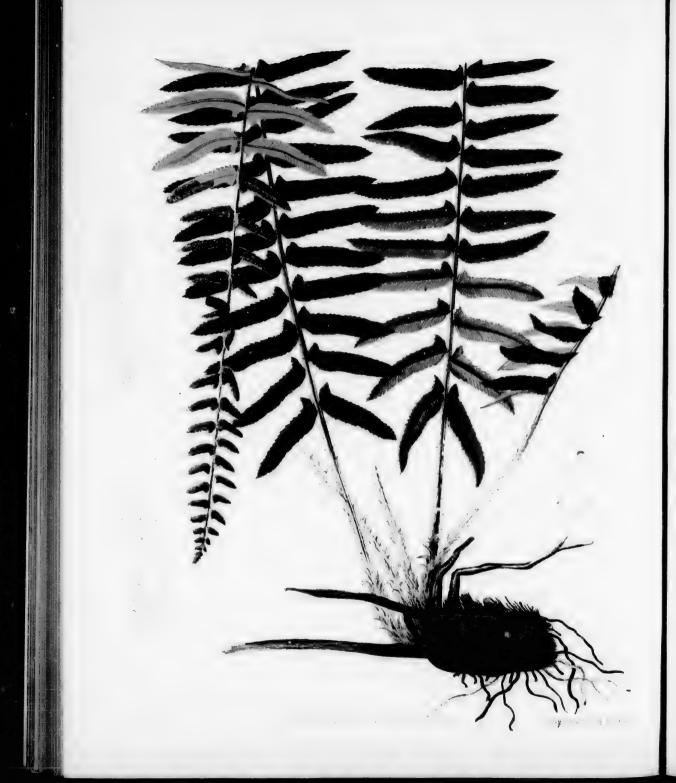
<sup>&</sup>lt;sup>1</sup> "§ II. OSMUNDOPTERIS. — Basis infima petioli gemmam includens rima longa verticali aperta; segmenti infimi primarii segmenta secundaria anadroma in superiore laminæ parte autem et tertiaria omnia catadroma. Gemma pilosa. Cellulæ epidermidis flexuosæ; stom3/2 in pagina laminæ sterilis superiore nulla." — Botr. Monogr., p. 96.

ovate in shape, and, in large fronds, pinnate with bipinnatifid lanceolate acute pinnæ. The middle primary division is broadly triangular, and has its lower pinnæ ample and bipinnatifid, and the successive ones gradually smaller and less compound. The ultimate divisions are oblong or oblong-ovate, and commonly incised-toothed along the sides and at the ends. Milde notices that the basal pinnæ of the lowest primary segments are on the upper side of the secondary rachis (anadromous), but that towards the apex of the frond the lowest pinnæ are on the lower side (catadromous), and that this arrangement prevails also in the divisions of the secondary segments. Var. gracile is nothing but a small form of the usual type. Var. cicutarium I have not seen: Milde gives Hayti and New Granada as the regions where it occurs. Var. Mexicanum has often a long stalk to the panicle, and the other differences are not any too constant.

The sterile segment is much thinner than in *B. ternatum*, and the epidermis is composed of cellules with sinuous margins. The fronds wither at the first frost.

Plate XXXIII. Botrychium Virginianum. — Fig. 1 is a plant of medium size, from Lynn, Massachusetts. The cleft at the bottom of the stalk, with its thin and semi-transparent edges, is well represented, and permits the enclosed bud to be distinctly seen. Fig. 2 is a cluster of sporangia, magnified. Fig. 3 is a spore, highly magnified.









#### PLATE XXXIV.

#### ASPIDIUM ACROSTICHOIDES, SWARTZ.

#### Christmas-Fern.

Aspidium acrostichoides:—Root-stock creeping, covered with adherent stalk-bases; stalks tufted, several inches long, very chaffy; fronds one to two feet long, evergreen, sub-coriaceous, lanceolate from a scarcely narrowed base, pinnate; pinnæ numerous, oblong-lanceolate, short-stalked, more or less upwardly falcate or the lowest ones slightly deflexed, pointed, abruptly narrowed at the lower side of the base, auricled on the upper side; margin serrulate with incurved bristle-pointed teeth, less commonly toothed or incised; veins free, branching; upper pinnæ of the fertile fronds contracted; sori terminal on the lower veinlets, often crowded and confluent when ripe; indusium orbicular.

Aspidium acrostichoides, Swartz, Syn. Fil., p. 44.—Schkuhr, Krypt. Gew., p. 193.—Willdenow, Sp. Pl., v., p. 225.—Pursh, Fl. Am. Sept., ii., p. 661.—Torrey, Fl. New York, ii., p. 497.—Gray, Manual, ed. ii., p. 599.—Mettenius, Fil. Hort. Lips., p. 88; Aspidium, p. 42.—Hooker, Sp. Fil., iv., p. 9.—Hooker & Baker, Syn. Fil., p. 250.—Williamson, Ferns of Kentucky, p.99, t. xxxvi.

Nephrodium acrostichoides, MICHAUX, Fl. Bor.-Am., ii., p. 267.

Polystichum acrostichoides, Schott, Gen. Fil.—Presl., Tent. Pterid., p. 83.—Gray, Manual, ed. i., p. 632.

Aspidium auriculatum, Schkuhr, Krypt. Gew., t. 30.

The following form deserves mention, but is scarcely sufficiently distinct to be regarded as a permanent variety:—

Var. incisum:—Pinnæ incisely toothed or even pinnatifid, those of the fertile fronds bearing sori at the tips clear to the base of the frond.—Grav. l. c.—Aspidium Schweinitzii, Beck, Botany of the United States North of Virginia, ed. i., p. 448.

HAB.—Shady hillsides, oftenest in rocky places; from New Brunswick and Canada westward to Wisconsin, and southward to Arkansas and Central Alabama. In Dr. Chapman's Flora Florida and Mississippi are also given, but I do not now find any specimens from those States. The species has not been found anywhere outside of North America.

DESCRIPTION.—This is one of the most abundant ferns of Eastern North America, and, having evergreen fronds, with a fine polish on the upper surface, it is well suited to the purpose of decorating our homes and churches at Christmas-time, whence the common name. The root-stocks creep just beneath the soil for a distance of several inches, and are thickly covered by the still attached bases of old stalks, from among which copious branching fibrous roots are emitted, and fasten the plant to the ground. The fronds rise in a graceful crown from the end of the root-stock, most of them appearing in early Spring, and remaining fresh and green until the new growth appears the next year. The stalks are from three or four to eight or ten inches long, and in the living plant are nearly terete, being slightly flattened on the anterior or upper side. They are full-green in color, becoming brownish at the very base. Usually they are chaffy, with large and small light-brown scales and chaffy hairs intermixed. This chaffiness

often follows the rachis nearly to the apex of the frond, but at other times it falls away long before the fronds begin to wither, leaving them almost perfectly smooth. A section of the stalk shows four or five roundish fibro-vascular bundles arranged in a semicircle, the two anterior bundles much larger than the others. The dried stalk is often deeply furrowed, owing to the contraction of the tissues between the two larger bundles.

The fronds in mature plants are from one to two feet long, and rarely as much as five inches broad. The pinnæ of such fronds number from twenty-four to thirty on each side, the uppermost ones becoming smaller and smaller, and the frond ending in a short incised or serrated point. The texture of the pinnæ is sub-coriaceous; the upper surface deep-green, smooth and shining in the living plant, but duller in dried specimens. The under surface is somewhat paler and scantily scurfy-puberulent or minutely chaffy. The largest pinnæ are from two to nearly three inches long, and about half an inch wide in the middle. In shape they are oblong or lanceolateoblong from a very unequal base, being suddenly narrowed to the short stalk on the lower side of the base, but on the upper side furnished with a well-developed triangular-ovate bristletipped auricle. The margin is normally finely serrulate with bristle-tipped incurved teeth; but very frequently the teeth are larger, so that the pinnæ are serrate or incised-serrate. This form, with incised-serrate pinnæ, is occasionally found in all parts of the country, and is indeed, as Prof. F. L. Harvey informs us, the common form in Arkansas. A sterile frond, with the pinnæ

much more deeply incised than any other which I have seen, was collected by Mr. F. Bourquin, near Pemberton in New Jersey, in 1867. In this frond the incisions are so deep as to render the pinnæ fairly pinnatifid.

The two lowest pinnæ of the frond are very often exactly opposite, and considerably deflexed: in the living plant they have the upper surface nearly horizontal, and are directed forward, side by side, nearly at a right angle to the rachis. The next two or three pairs are less exactly opposite, and less plainly deflexed. The remaining pinnæ are regularly alternate, and commonly show a slight upward curvature, rendering them somewhat scythe-shaped. The lower pinnæ are but very little shorter than those in the middle of the frond.

The veins of the sterile frond are free, as they are generally in the true *Polystichoid Aspidia*. Each vein is pinnately, rather than dichotomously, divided into about four veinlets, of which the lowest one is on the upper side of the vein. The midvein of the pinna, and the principal vein of the auricle are marked by a slight channel on the upper surface of the frond, but the veinlets are not conspicuous until the frond is dried, and are then most easily seen by holding up the specimen against the light.

In the fertile fronds, which are often rather taller, or at least more erect, than the sterile, the upper third part of the frond is suddenly contracted, so that the lowest fertile pinna is not more than two-thirds as long or wide as the sterile pinna next below it. The sori are borne near the midvein, either on

the lowest veinlet of each group, or on the two or three lower veinlets. A somewhat unusual thing in Aspidium occurs in the present species; the sori being mostly borne at the ends of the veins, which are enlarged into oval receptacles, much as in Polypodium. This peculiarity was observed by Dr. Mettenius, who says simply "soro terminali." In A. munitum many of the sori are also terminal on the veins, but in A. Lonchitis they seem to be uniformly dorsal. It is also noteworthy that the veinlets of a fruiting pinna are not uniformly free, but tend to form irregular scattered areoles.

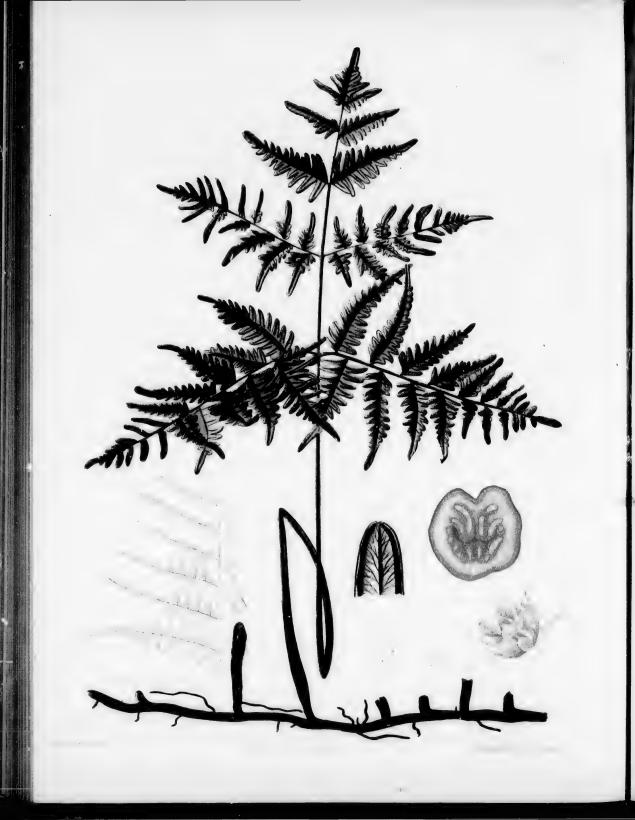
In var. *incisum* there is no sudden transition from ample sterile pinnæ to contracted fertile ones, but nearly or quite all the pinnæ of the fertile frond are soriferous, the sori pretty much covering the upper pinnæ, but confined to the tips of the lower ones.

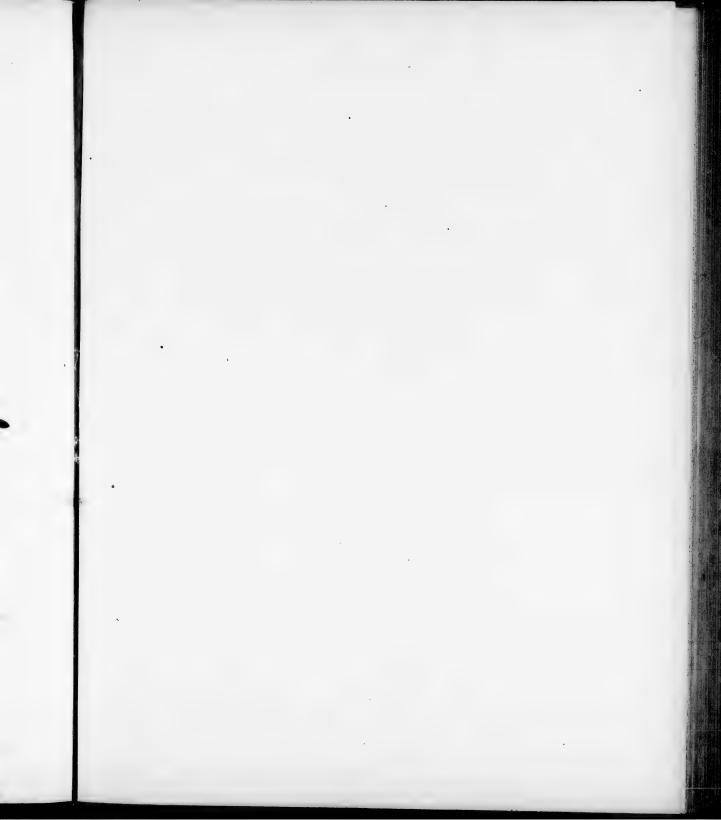
The indusium is orbicular and peltately attached at the centre: its margin is obscurely crenulate, but devoid of glands. The cellules of which it is composed have sinuous margins, and are arranged in lines which radiate from the centre. The pedicels which support the sporangia lengthen as the fruit ripens, so that at last the sporangia form one confluent mass on the back of the fertile pinnæ, looking not unlike the massed fructification of an *Acrostichum*, a resemblance which suggested to Michaux the specific name of the fern. I find fourteen or fifteen joints in the ring of the sporangia. The spores are ovoid or bean-shaped, and have a conspicuous irregular wing-like border.

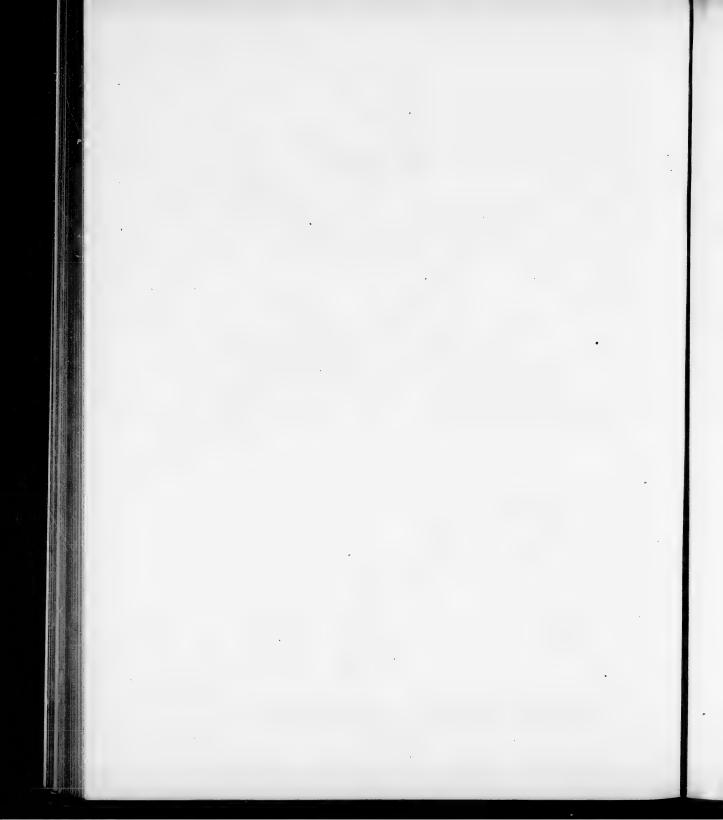
The Christmas-fern is very easily cultivated, but does best on slightly shaded rockwork.

Plate XXXIV. — Aspidium acrostichoides. A plant of the common form, showing a whole fertile frond and parts of two sterile fronds, the root-stock, etc. At one side is a pinna from the base of a fertile frond of var. incisum, and below it a pinna from the sterile frond from Pemberton, New Jersey, above referred to. The indusium is also represented.









#### PLATE XXXV.

# PTERIS AQUILINA, LINNÆUS.

## Bracken or Eagle-Fern.

PTERIS AQUILINA:—Root-stock cord-like, blackish, creeping widely underground; stalks solitary, erect, rigid, naked, swollen and discolored near the base, often more than a foot high; fronds sometimes three feet long and nearly as broad, triangular-ovate in outline, rigidly sub-coriaceous, smooth or pubescent, below twice or thrice pinnate; principal primary pinnæ stalked, the lowest ones very large, the middle and upper ones rapidly becoming smaller and simpler; pinnules oblong-lanceolate or linear, entire, hastate or pinnately parted; segments oblong or linear, obtuse, the terminal ones often elongated; veins close-placed, several times forked, free; involucre continuous round the edge of the pinnules, very often double.

Pteris aquilina, Linnæus, Sp. Pl., p.1533.—Michaux, Fl. Bor.-Am., ii., p. 262.—Swartz, Syn. Fil., p. 100.—Schkuhr, Krypt. Gew., p. 87, t. 95.—Willdenow, Sp. Pl., v., p. 402.—J. G. Agardh, Recens. Pteridis, p. 49.—Torrey, Fl. New York, ii., p. 448.—Gray, Manual, ed. i., p. 624, etc.—Moore, Nat. Pr. Brit. Ferns, t. xliv.—Hooker, Sp. Fil., ii., p.196, & iii., t. cxli, A, B.—Mettenius, Pteris, t. xvi., fig. 13-15.—Maximowicz, Prim. Fl. Am-

urensis, p. 341.—Hooker, Brit. Ferns, t. 38.—Bentham, Fl. Hongkong, p. 449.—Lawson, in Canad. Naturalist, i., p. 270.—Hooker & Baker, Syn. Fil., p. 162.—Miquel, Prolusio Fl. Jap., p. 172.—Milde, Fil. Eur. et Atlant., p. 45.—Williamson, Ferns of Kentucky, p. 43, t. vii, viii.

Allosorus aquilinus, PRESL, Tent. Pterid., p. 153.

Eupteris aquilina, Newman, History of British Ferns, ed., iii., p. 23.

For much other synonymy see Moore's work quoted above and Hooker's Species Filicum.

The following varieties are found in the United States, and have been considered distinct species, but both of them pass into the type by insensible gradations.

Var. lanuginosa, Bongard. — Fronds decidedly pubescent or silky-tomentose beneath; pinnules rarely caudate; segments ample. — Hooker, Fl. Am.-Bor., ii., p. 263; Sp. Fil., l. c. — Pteris lanuginosa, Bory, in Willdenow, Sp. Pl., v., p. 403. — Kaulfuss, Enum. Fil., p. 189. — Agardh, Recens. Pterid., p. 51.

Var. caudata, Hooker. — Fronds glabrous on both sides, or even somewhat glaucescent; pinnules and segments very narrow, the terminal ones much elongated. — Sp. Fil., ii., p. 196. — EATON, in CHAPMAN'S Flora, p. 589. — Pteris caudata, Linnæus, Sp. Pl., p. 1533. — Swartz, Syn. Fil., p. 101. — WILLDENOW, Sp. Pl., v., p. 401. — AGARDH, Recens. Gen. Pterid., p. 48. — GRISEBACH, Fl. Brit. W. I. p. 670. — Fée., 11me Mèm. p. 23.

HAB.—Very common on sunny hillsides, and in thickets, but found also in prairies and even in wet woods, the North American range being from Newfoundland through British America to Sitka, and southward to the Gulf of Mexico. It is the most widely distributed of ferns, and occurs, in one form or another, in all continents, and in most regions

of the world. Var. lanuginosa is common in the region west of the Rocky Mountains, being especially luxuriant in Oregon and Washington Territory. It has not been found in the Atlantic States, but is known in Europe, Southern Asia, Africa, etc., etc. Var. caudata, a West Indian form, is not rare in Florida, and has been collected in Southern Alabama, and perhaps in others of the Gulf States. The Australian Var. esculenta, which occurs abundantly in South America, has not been found within our limits.

Description. — The bracken has a subterranean creeping root-stock, often much elongated, from the sides of which the stalks grow alternately, scattered along at variable distances, though only one frond is produced each year. The root-stock is about three or four lines thick (Moore says as thick as one's little finger), the outside very black and somewhat velvety. The upper and under sides are rounded, but there is a slightly prominent rather sharp ridge, running along each side. The transverse section is very interesting, and may be seen figured, though on too small a scale, at page 354 of the English edition of Sach's Text-Book of Botany. Within the dark exterior sheath of sclerenchyma may be seen the soft whitish parenchymatous mass, containing two somewhat flattish bands of very firm sclerenchyma. Between these are two flattish-oval fibro-vascular bundles, one above the other, while around the sclerenchyma-bands are about a dozen smaller rounded or oval fibro-vascular threads arranged in a rude circle. The stalks very often rise from short lateral branches of the root-stock, rather than from the root-stock itself. These branches continue

growing year after year, and so a single plant may in time become a whole colony. Close to the growing end of the rootstock is a very short bud, which would develop into a stalk and frond in two years' time: a short distance back of this is a bud an inch or two long, at the top of which may be plainly seen the infolded rudimentary frond for the next year; and back of this is the stalk for the frond of the present year.

There back still are the decaying remains of the stalks which have supported fronds in previous seasons.

The stalks have the portion beneath the surface of the ground considerably swollen, and blackened like the root-stock. They are erect, and sometimes attain to the height of several feet above the surface. Their color is commonly a dull reddish-brown, sometimes a pale straw-color. The surface is devoid of chaff, and the anterior side is moderately furrowed. A cross-section shows a central mass of sclerenchyma, in which there are about three narrow ridges projecting anteriorly and two posteriorly from a transverse band; between these ridges are oval or flattened isolated bands of fibro-vascular tissue, and numerous smaller threads of the same tissue surround the whole central mass. This is the structure of a very young stalk, and may perhaps vary a little as the stalks become mature. The whole appearance of the section has been likened to the heraldic "displayed eagle;" and one of the common names as well as the specific name, has reference to this resemblance. But it is also said that King Charles in the Oak may be seen in the stem of the bracken.

The frond is broadly ovate-triangular in outline, the breadth being nearly or quite equal to the length. The size varies much according to soil, climate, etc.; so that while plants may be mature, and yet have fronds less than a foot high, they frequently are found from three to five feet high. These dimensions are exceeded in Oregon, where the bracken forms thickets six or seven feet high. Hooker and Baker report that Dr. Spruce has seen it fourteen feet high in the Andes. The rachis of the frond bends away abruptly from the top of the stalk, and the short petioles of the two lowest primary pinnæ bend similarly, but in other directions. The effect is to make the frond spread obliquely in three different directions, a peculiarity which is lost when specimens are pressed for the herbarium. Very large fronds are fairly tripinnate at the base; smaller ones only bipinnate. Above the base of the frond the primary pinnæ rapidly become smaller, so that the pinnæ of the fifth pair are about the same size and degree of composition as the lowest secondary pinnæ of the lowest primary pinnæ. The secondary pinnæ are oblong lanceolate, nearly sessile, and usually pinnatifid almost to the midrib into numerous rather obtuse oblong segments, besides a terminal segment, which is often much longer than any of the lateral ones. Sometimes the side lobes are reduced to a single basal pair, and the pinna is then hastate, and again the lobes may be entirely separated, and thus become distinct entire pinnules. The ultimate segments, or lobes, are so variable in length and breadth, that it is not easy to give average measurements. But it may, perhaps, be said that in the common form they are from one-fourth to three-fourths of an inch long, and from two to three lines wide. When they are larger than this they are almost always more or less lobed at the base. In var. caudata entire pinnules may be seen over an inch long, and less than one line wide. The upper surface is smooth; the lower surface slightly pubescent in the plant of the Northern Atlantic States, tomentose in the plant of the region of the Rocky Mountains, and perfectly smooth in the variety which occurs in the States bordering the Gulf of Mexico. The frond is rigid in texture, and though it turns to a dingy brown in autumn, it does not wither much before the appearance of the new growth of the following year.

The veins are free, and forked into several more or less curved veinlets, which are slightly prominent on the under surface, and marked by faint depressions on the upper.

The sporangia are seated on a continuous vein-like marginal receptacle, and are covered by a delicate reflexed marginal involucre. Very often there is a second involucre, growing from the *inner* side of the receptacle, differing a little in the shape of the cellules from the outer involucre, but like it delicately ciliated with simple or jointed hairs.\*

The genus Pteris consists of about one hundred species,

<sup>•</sup> Dr. Mettenius, in his paper on Pteris, has given good figures and descriptions of these two involucres. He considers the outer one to be the margin of the frond, and the inner one the true indusium. Consult also Hooker, in his Species Filicum, vol. II, p. 195, and compare the figures in the first plate of vol. III, of the same work.

of which rather more than half have variously reticulated veins, and are placed in sections arranged principally according to the different modes of this reticulation. Section Eupteris, with free veins and a single involucre, consists of about forty species, and is represented in the United States by two or three southern species. Pteris aquilina, with a few related species, all with free veins, a creeping root-stock, and a double involucre, forms the section or subgenus Pasia. Section Heterophlebium, with veins anastomosing only near the margin, consists of two South American species. Campteria, with the veins of the next to the last divisions connected by arching veinlets at the base, has half a dozen species, mostly in the tropical parts of the Old World. Doryopteris, with small sagittate or pedate fronds, and copiously reticulated veins, has about ten species, mostly in Tropical America, one of which, P. pedata, was wrongly attributed by Pursh to Virginia. Litobrochia, with copiously anastomosing veins, and fronds otherwise like those of § Eupteris, some of them very large and decompound, has about thirty species in the warmer parts of both hemispheres; and Amphiblestra, consisting of a single Venezuelan fern, has copiously anastomosing veins and free included veinlets, the latter a character which is not seen in the other sections of the genus.

The bracken is a familiar plant to all people who know anything of forest or field, and often lends its name to any large fern, Osmundas and Aspidiums being perhaps better known as brakes, than as royal-ferns and shield-ferns.

In "The Lady of the Lake," when the Heir of Arman-

dave is met at the church-door, and the fiery cross is put into his hand, to bear to the clansmen of Roderick Dhu, the bridegroom leaves his bride, and begins his way over mountain and moor with the song;—

"The heath this night must be my bed,
The bracken curtain for my head,
My lullaby the warder's tread,
Far, far, from love and thee, Mary."

Plate XXXV.—Pteris aquilina. The frond chosen is a small one from New England. At the left is part of a frond of var. caudata; at the right, the under side of a pinnule showing the fruit, a section of the lower part of the stalk, and a section of the fertile pinnule, the latter much enlarged.



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#### PLATE XXXVI. - Fig. 1-3.

## ASPLENIUM TRICHOMANES, LINNÆUS.

#### Maidenhair-Spleenwort.

Asplenium Trichomanes:—Root-stock short, the slender blackish scales having a strong midnerve; stalks densely clustered, one to five inches long, nearly black, shining and very narrowly margined, as is the rachis, which persists after the pinnæ are fallen; fronds two to eight inches long, or even longer, narrowly linear in outline, rather rigid, evergreen, pinnate; pinnæ numerous, very short-stalked, roundish-oval or ovaloblong from an obtusely cuneate or truncate base; the margin entire or crenulate, or rarely incised; midvein nearly central; veins few, oblique, usually once forked; sori oblong, commonly from three to six each side of the midvein, but in large forms more numerous; indusia membranaceous, entire or obscurely crenated, rarely toothed.

Asplenium Trichomanes, Linnæus, Herb.!; Sp. Pl., p. 1540 (in part).—
Hudson, "Flora Anglica, ed. i. (1762), p. 385."—Міснаих, Fl.
Bor.-Am., ii., p. 264.—Swartz, Syn. Fil., p. 80.—Schkuirr,
Krypt. Gew., p. 69, t. 74.—Willdenow, Sp. Pl., v., p. 331.—
Torrey, Fl. New York, ii., p. 491.—Ruprecht, Distr. Crypt. Vasc.
in Imp. Ross., p. 44.—Gray, Manual.—Newman, Hist. Brit. Ferns,
ed. iii., p. 249.— Moore, Nat. Pr. Brit. Ferns, t. xxxix.—Mettenius, Fil. Hort. Lips., p. 72; Asplenium, p. 138.—Heufler, Aspl.

Sp. Eur., p. 268.—HOOKER, Sp. Fil. iii., p. 136; Brit. Ferns, t. 29.

—MILDE, Fil. Eur. et Atl., p. 63.—HOOKER & BAKER, Syn. Fil., p. 196.—J. D. HOOKER, Syn. Fl. New Zealand, p. 371.—McKen, Ferns of Natal, p. 12.—Williamson, Ferns of Kentucky, p. 61, t. xvi.

- Asplenium melanocaulon, WILLDENOW, "Enum. 1072;" Sp. Pl., v., p. 332.—
  PURSH, Fl. Am. Sept., ii., p. 666.—FOURNIER, Pl. Mex., Crypt., p. 104.

  (The common North American plant.)
- Asplenium castaneum, Schlechtendal & Chamisso, in Linnæa, v., p. 611.—
  Liebmann, Mex. Bregn., p. 88.—Mettenius, Asplenium, p. 137.
  —Fournier, Pl. Mex., Crypt., p. 104. (A very large Mexican form.)
- Asplenium anceps, Solander, "in Lowe, Primitiæ Faunæ et Flor. Mader, p. 8." Hooker & Greville, Ic. Fil., t. exev. (A large form from Madeira, the Azores, etc.)
- Asplenium densum, Brackenridge, Fil. U. S. Expl. Exped., p. 151, t. 20.

  (A rigid and contracted form, with more winged rachis and lacerated indusia; from the Hawaiian Islands and Peru.)

Var. incisum, Moore, Nat. Pr. Brit. Ferns, t. xxxix, fig. D and E. — Pinnæ incisely lobed, the lobes often crenated or serrate. — Trichomanes foliis eleganter incisis, Tournefort, "Instit., p. 539, t. 315, fig. C." — Asplenium Trichomanes, β. Linnæus, l.c. — Schkuhr, l.c. t. 74, fig. f. — Asplenium Trichomanes, var. lobato-crenatum, De Candolle, Milde, Fil. Eur. et Atl., p. 63. (For accounts of several European and Atlantic varieties see Milde's work just quoted.)

HAB.—Crevices of shaded rocks, sometimes on old walls also. Common in North America from Canada to British Columbia, and throughout the United States to Alabama, Texas, Colorado, California and Oregon. Also in Europe, Asia, South Africa, New Zealand and

the Hawaiian Islands. The plant of Madeira, the Azores, Bermuda, the West Indies, Mexico and the northern parts of South America, is chiefly the large form called *Asplenium anceps* by Solander, or the still larger *Asplenium castaneum* of Schlechtendal and Chamisso. Var. *incisum* has been found near Brattleboro', Vermont, by Mr. C. C. Frost, and is frequently collected near San Diego, California, where the type does not seem to occur.

Description.—The maidenhair-spleenwort loves the mossy crevices of a shaded cliff, and will cling with its strong rootlets so closely to the rock, that it is not easy to take the plant uninjured from its home. The root-stock is short, and covered with fine reddish-black lance-acuminate scales, which are composed of oblong-quadrate cells. Each scale has a very evident midnerve of firmer tissue than the rest of the scale. The fronds spread in all directions from the root-stock, but are very frequently all curved slightly to one side, giving the whole cluster a spiral appearance. In the United States the fronds are usually from three to six inches long, besides the stalk which is one-third or one-fourth as long as the frond. But in the islands of the Atlantic and in Tropical America a plant is found, not safely separable from the present, which has fronds very much longer. Some very fine specimens, collected in Bermuda by Professor G. B. Goode, are fully fifteen inches high.

The stalks are nearly black, and have the same bright polish which we see in the maidenhair. The section is rounded at the back, flat or slightly furrowed in front, and shows a single fibro-vascular bundle in the middle. The rachis is black like the stalk, and persists long after the pinnules have fallen off.

The fronds are narrowly linear in outline, evergreen, and bear a great number of little pinnæ, which are articulated to the rachis, and leave 'a scar when they drop off, as they do about a year after the frond is produced. The pinnæ are smooth, dark-green above, a little paler beneath, and vary much in shape. On small fronds they are roundish-obovate, and scarcely a line long; in larger fronds they are oblong-oval, four or five lines long, and have the base broader on the upper side than on the lower. The margin is either entier, or crenulate, or toothed, or in var. incisum incised with toothed The sori are usually few in number, borne on the upper side of the mostly once-forked veins, oblong in shape, and covered by a delicate indusium composed of very tortuous cells and having commonly a slightly crenulate margin. The sporangia have a ring of about seventeen joints, and the spores are ovoid and roughened with irregular anastomosing winged ridges.

Plate XXXVI., Figs. 1-3.—Asplenium Trichomanes. Fig. 1 is the common form; the specimen drawn is from Connecticut. Fig. 2 is a fruiting pinna, enlarged. Fig. 3.—A sterile frond of var. incisum, from Vermont. The San Diego plant has slightly larger fronds, and pinnæ somewhat less incised.

#### PLATE XXXVI. - Fig. 4.

## ASPLENIUM VIRIDE HUDSON.

#### Green Spleenwort.

ASPLENIUM VIRIDE:—Root-stock short, creeping, entangled and forming large tufts; the scales blackish and without a midnerve; stalks brownish at the base, becoming greenish higher up and passing into a green herbaceous rachis; fronds two to five inches long, linear-lanceolate, softly herbaceous, bright-green, pinnate; pinnæ numerous, short-stalked, roundishovate or ovate-rhomboid, more or less cuneate at the base, crenated; midvein indistinct and passing into the simple or forked veinlets; sori few, remote from the margin; indusia very delicate, entire or denticulate.

Asplenium viride, Hudson, "Fl. Anglica, ed. i. (1762), p. 385."—Swartz, Syn. Fil., p. 80.—Schkuhr, Krypt. Gew., p. 68, t. 73.—Willdenow, Sp. Pl., v., p. 332.—Hooker, Fl. Bor.-Am., ii., p. 262.—Newman, Hist. Brit. Ferns, ed. iii, p. 243.—Koch, Syn. Fl. Germ. et Helv., ed. iii., p. 737.—Moore, Nat. Pr. Brit. Ferns. t. xl.—Mettenius, Fil. Hort. Lips., p. 72; Asplenium, p. 139.—Heufler, Aspl. Sp. Eur., p. 255.—Hooker, Sp. Fil., iii., p. 144; Brit. Ferns, t. 30.—Milde, Fil. Eur. et Atl., p. 60.—Hooker & Baker, Syn. Fil., p. 195.—Lawson, in Canad. Naturalist, i., p. 275.

Asplenium Trichomanes, LINNÆUS, Sp. Pl., p. 1540 (The Lapland plant.)

Asplenium intermedium, PRESL, "Delic. Prag. i., p. 223; Tent. Pterid., p. 108, t. iii, f. 22.

HAB.—On shaded rocks, from New Brunswick and northern New England to the Rocky Mountains and British Columbia. In Canada it has been found at Gaspé by Mr. John Bell, near Tadousac and at the falls of Rivière du Loup by Mr. Watt, and in fissures of calcareous rocks at Owen Sound, by Mrs. Rov. Mr. C. G. Pringle has detected it in the mountains of Vermont; it was collected long ago in the Rocky Mountains by Drummond, and again, in 1858, by Bourgeau. Dr. Lyall found it at Fort Colville, and Milde states that he has seen a dwarfed specimen from Sitka, collected by Eschscholtz. It is found in Europe, mostly in mountainous regions, from Lapland to Spain, Italy and the Caucasus, and has been collected also in Eastern Siberia.

Description.—The green spleenwort is not unlike the maidenhair-spleenwort in general appearance, and was confused with it by Linnæus. The plant, when it finds a station exactly suitable to its best development, forms a great bed of matted root-stocks, as it does, for instance, on a shaded cliff on a hill near Interlaken, in Switzerland. The root-stocks are scaly with narrow slender-pointed scales, which are composed of oblong-quadrate cellules throughout, and have no midnerve, or at most the merest rudiment of one. The fronds are more erect than those of A. Trichomanes, but do sometimes exhibit the same tendency to a spiral arrangement. The stalks are bright-brown at the base, but a little higher up the color passes first into stramineous and then into green, which is the color of the rachis. The stalk lacks the narrow margins of A. Tri-

chomanes, and the single fibro-vascular bundle has a slightly different structure. The fronds are linear-lanceolate, rather than linear, and end in a longer toothed or pinnatifid apex. The pinnæ do not fall away from the rachis, but when they wither the rachis withers also. Though the fronds are evergreen, surviving the winter, they are delicately herbaceous in texture, and the color is a pale though clear shade of green. The numerous pinnæ vary in shape from nearly round to rhomboid-ovate, the lower ones being commonly shorter, rounder and more distant, than those in the middle of the frond. The base is more or less wedge-shaped. The outer margins are crenated, or even incisely crenate. In different specimens the pinnæ vary in length from a line and a half to three or even four lines.

The midvein bears a few veinlets on each side; the lowest veinlets are forked, sometimes twice forked; the upper ones are simple, the midvein itself being as slender as the veinlets, and, like them, stopping short of the margin of the pinna.

The sori are few, and are placed low down on the upper side of the veinlets, so as to be much nearer the midvein than the margin. The indusium is very delicate, and has its free edge either entire or toothed. The sporangia have a ring of sixteen or seventeen joints. The spores are ovoid or roundish, margined by a very broad wing, and covered with irregularly reticulated ridges.

The green rachis will at once distinguish this plant from A. Trichomanes; but there are several little Asplenia in the

Southern Hemisphere to which it is more closely related, and from some of these it would not be so easy to distinguish it. A. Kraussii, from Natal Colony, is perhaps the most closely allied, but the pinnæ are more one-sided, and are sharply toothed only on the upper margin, the lower being entire. A Quitense of Hooker (Second Century of Ferns, t. xx) is also much like A. viride, but has an elongated slender creeping root-stock, a narrowly winged rachis, and some other differences. A. fragile, from Peru and the Hawaiian Islands, and A. flabellifolium, from Australia and New Zealand, are also nearly related to the fern here described.

There is in Silesia and Bohemia a fern almost exactly intermediate between this species and A. Trichomanes, the A. adulterinum of Milde. It has the thinner pinnules and the wingless rachis of A. viride, but in the color of the stalk and lower part of the rachis, as well as in the position of the sori, it is like A. Trichomanes. Milde believed it to be certainly a hybrid, but German botanists now regard it as a distinct species. It is said never to grow in company with A. viride.

Plate XXXVI., Fig. 4, is drawn from a plant of *Asplenium viride* collected in Royston Park, Owen Sound, Ontario, Canada, by Mrs. Roy. European specimens are sometimes considerably larger.

# PLATE XXXVI.—Figs. 5, 6. ASPLENIUM PARVULUM, MART. & GAL.

#### Little Ebony-Spleenwort.

Asplenium parvulum:—Root-stock short, creeping; the scales nearly black, very opaque and rigid; stalks short, black and shining like the rachis; fronds erect, rigid, four to ten inches high, narrowly linear-oblanceolate, pinnate; pinnæ numerous, rigid-chartaceous, mostly opposite in pairs, nearly sessile, more or less deflexed, two to six lines long, oblong, obtuse, entire or crenulate, auricled on the upper side of the base, the lower ones auricled on both sides, gradually shorter, and more deflexed; sori oblong, midway between the midrib and the margin.

Asplenium parvulum, Martens & Galeotti, Syn. Fil. Mex., p. 60, t. 15, f. 3.—Fee, Gen. Fil., p. 192; Cat. Fil. Mex., p. 15.—Eaton, Ferns of the South-west, ined.

Asplenium resiliens, Kunze, in Linnæa, xviii., p. 331.—Liebmann, Mex. Bregn., p. 88.— Fournier, Pl. Mex., Crypt., p. 103.

Asplenium trichomanoides, Kunze, in Silliman's Journal, July, 1848, p. 85.—Mettenius, Asplenium, p. 137 (not of Michaux, which is A. ebeneum).

Asplenium ebeneum, var. minus, Hooker, Sp. Fil., iii., p. 139.

Asplenium ebeneum, Eaton, in Botany of Mexican Boundary, p. 235.

HAB.—On shaded rocks, generally limestone. Northern Alabama, Hon. T. M. Peters; Lookout Mountain, Tennessee, and in Georgia, Dr. Chapman; Arkansas, Prof. F. L. Harvey; Great Cañon of the Rio Grande, Dr. Parry; Texas, E. Hall. Kunze gives Georgia and Tennessee, collected by Beyrich, and about Dandridge, Tennessee, Rugel. It is found also in several parts of Mexico, extending as far south as Chiapas. Fournier considers the Hawaiian A. densum of Brackenridge to be the same thing, in which he is surely wrong, and gives also Japan, I know not on what authority.

Description.—This has certainly a very close resemblance to A. ebeneum, of which Hooker considered it a variety, and to which I once referred a specimen from the Rio Grande. The outline of the frond is similar, and the pinnæ have much the same shape. The present plant is, however, uniformly smaller, more rigid, and with pinnæ of thicker texture. The pinnæ are almost always opposite, while in A. ebeneum they are as uniformly alternate. Here they are entire, or nearly so, while there they are usually serrate. The scales of the rootstock in the present species consist mainly of a very heavy, far excurrent, black midnerve, while in the other they have no midnerve at all, and consist wholly of lattice-like cellules. The pinnæ of A. parvulum are more deflexed, a character which shows most plainly in the Mexican specimens.

Plate XXXVI., Figs. 5, 6. Asplenium parvulum. Fig. 5 is a plant from Northern Alabama, collected by Hon. T. M. Peters. Fig. 6 is a pinna, enlarged and showing the veins and the sori.









#### PLATE XXXVII.

# ADIANTUM CAPILLUS-VENERIS, LINNÆUS.

Venus-Hair. Maiden-Hair.

ADIANTUM CAPILLUS-VENERIS:—Root-stock creeping, scaly; stalks crowded, a few inches to a foot long, very slender, black and shining, as are the rachis and all its divisions; fronds a span to a foot and a half long, often pendent, ovate or ovate-lanceolate in outline, delicately membranaceous, smooth, simply pinnate towards the apex, below twice or even thrice pinnate; pinnules and upper pinnæ six to twelve lines long, wedge-obovate or somewhat rhomboid, rather long-stalked, the sides straight or slightly concave, the upper margin often deeply and irregularly incised; the ends of the lobes crenate or acutely denticulate, except where the margin is recurved to form the lunulate or transversely oblong separated involucres.

Adiantum Capillus-Veneris, Linnæus, Sp. Pl., p. 1558.—Swartz, Syn. Fil., p. 124.—Willdenow, Sp. Pl., v., p. 449.—Hooker, Sp. Fil., ii., p. 36, t. lxxiv, B; British Ferns, t. 41.—Moore, Nat. Pr. Erit. Ferns, t. xlv; Index Fil., p. 20.—Koch, Syn. Fl. Germ. et Helv., ed. iii., p. 738.—Eaton, in Bot. Mex. Bound. Survey, p. 233; Chapman's Flora, p. 591.—Grisebach, Fl. Brit. W. Indies, p. 666.—Hooker & Baker, Syn. Fil., p. 123.—Milde, Fil. Eu. et Atlant., p. 30.—McKen, Ferns of Natal, p. 5.—Beddome, Ferns of Southern India, p. 2, t. iv.—Keyserling,

Gen. Adiantum, in Mem. Acad. Petrop., ser. vii., xxii., No. 2, p. 15, 37.—Benthan, Fl. Austral., vii., p. 723.

Adiantum Capillus, Swartz, "in Schraders Journal, ii. (1800), p. 83."

— Link, Fil. Hort. Berol., p. 70. — Kunze, in Linnæa, x., p. 500; xxiii., p. 215; xxiv.; p. 273; Silliman's Journal, July, 1848, p. 87.

Adiantum emarginatum, Bory, in Willdenow, Sp. Pl., v. p. 449 (not of Hooker, Sp. Fil., ii., t. lxxv, A).

Adiantum Moritzianum, Link, Fil. Hort. Berol., p. 71. Adiantum dependens, Chapman, MS.

Hab.—In moist rocky places, especially about springs and along water-courses; from Wilmington, North Carolina, to Florida, Alabama, Texas, Arkansas, Utah, Arizona and the southern part of California. Mexico to Venezuela, West Indies, Azores, Madeira, Europe, Asia, Africa, Australia and Polynesia. Near Wilmington, where it was collected by Mr. W. M. Canby on the banks of the Cape Fear River, and about Santa Barbara, where it seems to be abundant in the canons of the Coast Range, it passes a little to the north of the thirty-fourth degree of North Latitude, but in North Western Arkansas, where Prof. F. L. Harvey found it growing luxuriantly in the crevices of sandstone rocks which border the White River, it passes fairly above the thirty-sixth degree.

Description.—Root-stock creeping, rather short, not thicker than a crow-quill, scaly. The scales, which are found also on the very lowest part of the stalk are small, narrowly lanceolate, slender-pointed and entire. They are dull-brown in color, and are composed of irregularly elongated cells. The stalks are from a few inches to a foot high, very slender, nearly black on the back, dark vinous-red on the front, and very highly polished. Under a strong lens they are seen to be finely striated

longitudinally. The section shows within an exterior of thick-walled cells a pale parenchyma containing two slender fibrovascular bundles, which are considerably separated at the base, but gradually approach each other higher up, and unite near the top of the stalk. The rachises and the stalks of the pinnules are almost as slender as hairs, and have the same dark color and brilliant lustre as the stalk.

This fern, whenever it grows luxuriantly, is more or less pendent in habit, but plants of moderate size commonly have the fronds erect or but slightly recurved. One of Professor Harvey's fine specimens has a frond seventeen inches long, but usually the fronds are scarcely half as long as this. They vary in shape from triangular-ovate to ovate-lanceolate, and in composition from simply pinnate with a scantily bipinnate base, to fully tripinnate, for the lower half of the frond at least. The pinnæ and pinnules are alternate, and the lower ones rather distant, the upper more crowded. The pinnules are from four lines to an inch long, and are in general fanshaped, sometimes with a very acute base, sometimes with a truncate base. They are now narrowly obovate-wedge-shaped, and now decidedly rhomboid, and again almost round, but always distinct from each other, and supported on capillary footstalks from one to four lines long. The lower sides of the pinnules are entire, and usually slightly concave; the upper or outer margin is more or less incised or lobed, and the lobes, in American plants, usually denticulate, sometimes very sharply so. European and East American specimens have

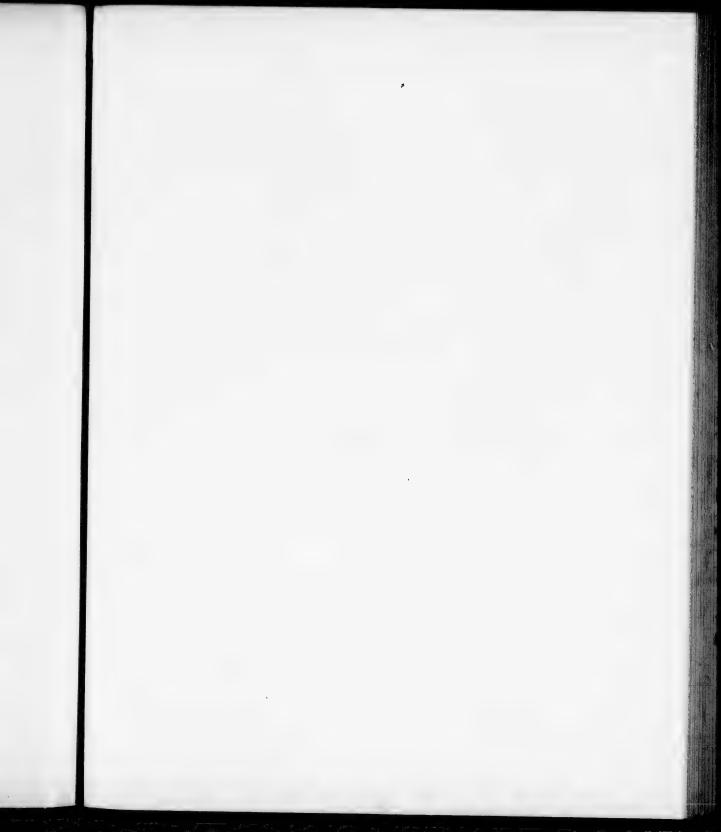
these teeth not very well developed; but the plant of Utah and California has very sharp teeth, the veinlets running to the points of the teeth. The degree of incision varies very much, and a plant incised but little more than that which is shown in the middle of our plate was figured in Species Filicum as "var. 3 pinnis profunde incisis."

In fertile fronds the teeth either disappear, or are seen only on the upper part of the sides of the lobes, and the ends of the lobes are occupied by the lunate or transversely oblong involucres. The spores are smooth, globose-tetrahedral, and faintly marked with three radiating vittæ. The veins are free, and flabellately forked from the base of the pinnules.

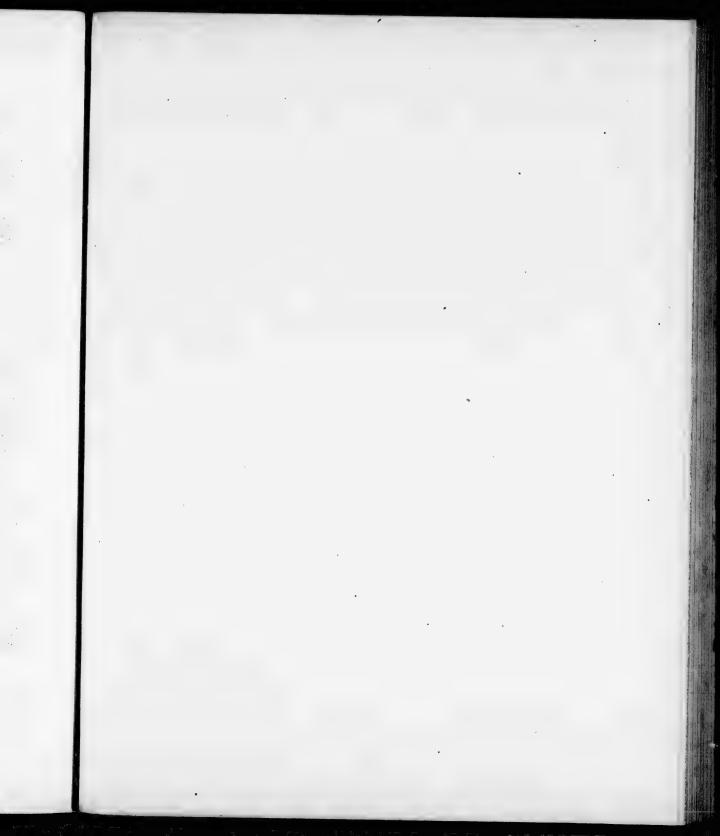
The group of *Adiantum*, to which this species belongs, is characterized by having ovate-pyramidal fronds (at least bipinnate) fan-shaped pinnules, and forking veinlets with no midvein. It includes over a dozen species, which are not always easy to be distinguished from each other.

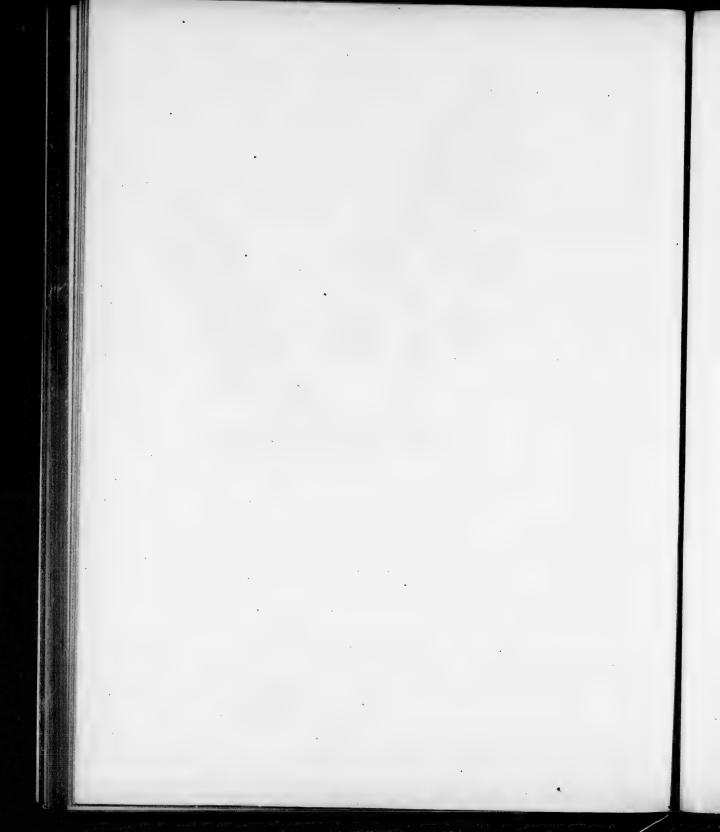
Plate XXXVII. — Adiantum Capillus-Veneris. The colored plant in the middle of the plate was collected by Mrs. Stanley Bagg near Santa Barbara, California, and represents a form with few very large and deeply incised pinnules. The frond drawn in outline is from the White River, Arkansas, and was collected specially for this plate by Professor F. L. Harvey. The details are a fruiting pinna, slightly enlarged, the end of one lobe magnified, and a spore highly magnified.

• Since these pages were stereotyped I have learned that this species and Asplenium parvulum have been found in Greene County, Missouri, by Mr. E. M. SHEPARD.









#### PLATE XXXVIII. - FIG. 1-3.

# ADIANTUM EMARGINATUM, HOOKER.

#### Californian Maiden-Hair.

ADIANTUM EMARGINATUM:—Root-stock creeping, scaly; stalks clustered, a few inches to a foot long, wiry, dark and shining, like the rachis and branchlets; fronds six to twelve inches long, mostly erect, broadly ovate or deltoid-pyramidal, twice or thrice pinnate at the base, simpler upwards; pinnæ obliquely spreading, lower ones half as long as the frond; pinnules long-stalked, four to fifteen lines broad, roundish or semicircular, or even somewhat reniform, lower sides entire; outer edge rounded, slightly two to five-lobed, finely and sharply toothed in the sterile fronds, but in the fertile recurved to form pale transversely elongated involucres; veins flabellately forking, the veinlets extending to the ends of the teeth.

- Adiantum emarginatum, Hooker, Sp. Fil., ii., t. lxxv., A, not of Bory and Willdenow.—Keyserling, Gen. Adiantum, in Mem. Acad. Petrop., ser. vii., xxii., No. 2, p. 15, 37.—EATON, Ferns of the South-West, ined.
- Adiantum Chilense, Torrey, in Pacif. R. R. Survey, iv., p. 160, vii., p. 21.—Brackenridge, Ferns of U. S. Ex. Exped., p. 97.—Eaton, in Botany of the Mexican Boundary, p. 233, and in Robinson's Catalogue, not of Kaulfuss.

Adiantum tenerum, Torrey, in Emory's Notes of a Military Reconnoissance from Fort Leavenworth to San Diego, p. 155.—Newberry, in Pacif. R. R. Survey, vi., p. 93, not of Swartz and Willdenow.

Adiantum Æthiopium, BAKER, Syn. Fil., p. 123, as to the Californian plant only.

HAB.—Among rocks, and in cañons, both moist and dry; from San Diego, California, to Oregon, not rare in the Coast Ranges, but apparently unknown east of them.

Description.—This species belongs to the same group as the Venus-Hair, but is easily distinguished from it by the much broader and less deeply lobed pinnules and by the transversely elongated involucres. The root-stock is rather slender, creeping, and chaffy with amber-brown entire lanceolate-acuminate scales. The stalks are several from one root-stock. They are a little stouter than in the Venus-Hair, but have the same brilliant lustre. They are nearly black on the back, and a dark mahogany red in front. The vascular bundle is single to the very base in the specimen examined, and is somewhat V-shaped. The stalks are from six inches to a foot long, and support a frond of about the same length. The fronds are nearly or quite half as wide at the base as they are long, and are oftenest exactly ovate-triangular in outline. The largest fronds are tripinnate in the lower part, bipinnate in the middle, and simply pinnate towards the apex, where also the pinnæ often overlap each other a little. The pinnules are papery-membranaceous in texture, clear-green above, slightly paler beneath, bearing a few scattered hairs along the veins when young, but soon quite smooth. The pinnules are sometimes roundish, but more frequently broader than long, so as to be semicircular or even slightly reniform. They are commonly either truncate at the base, or broadly wedge-shaped, and have slender footstalks from two to five lines long. In sterile fronds the outer margin is finely and sharply toothed, the veinlets running out into the points of the teeth, and even a little beyond the points, so as to make them slightly aculeate. The margin is also slightly notched in from one to four or even more places. In fertile fronds the teeth are formed only at the extreme sides of the pinnules, and the margin of the lobes is recurved, forming palish elongated involucres, which are perfectly smooth.1 The veins are flabellately forked from the end of the footstalk, and are slightly prominent on both surfaces. The sporangia have a ring of seventeen or eighteen articulations. The spores are tetrahedral with rounded angles and slightly concave sides. They have a minutely roughened surface, and have the three vittæ of the genus.

This species was formerly confused with Adiantum Chilense, which it considerably resembles, but that species has

<sup>&</sup>lt;sup>1</sup> Keyserling says there are two involucres on the upper pinnules, and four on the lower ones; but the upper pinnules often have four, and the lower ones rarely as many as eight. Usually the middle notch is deepest, so that although the name *emarginatum* was not originally intended for this fern it is not so unsuitable that we must reject it.

rounded-reniform involucres, and the veinlets run to the notches between the teeth, not to the teeth themselves. The A. emarginatum of Bory, from Mauritius, is now ascertained to be a form of A. Capillus-Veneris. Hooker's figure in Species Filicum, though taken from a specimen in his herbarium, marked "Malacca, Griffith," resembles no known Adiantum of either Malacca or Mauritius. It is on the same sheet with one much more like A. Capillus-Veneris, which is marked as coming from Delessert's herbarium, and as collected in the Mauritius. It is possible that the labels have been interchanged, an accident which happens sometimes in every herbarium. Keyserling conjectures that the specimen figured came from California, by way of Delessert's collection; and as it is exactly our plant, the conjecture is probably correct. It is interesting to note that in Hooker's herbarium is a specimen from California, collected by Dr. Hillebrand, marked by Sir W. J. Hooker's own hand; - "Ad. Cap.-Ven. -same form as Ad. emarginatum, Bory in Hk. Sp. Fil. t. 75."

Plate XXXVIII.—Fig. 1-3. Adiantum emarginatum. Fig. 1 is a frond with unusually large pinnules, collected near Ukiah, California, by Dr. Kellogg. Fig. 2 represents two sterile pinnules of a smaller specimen. Fig. 3 is a spore, highly magnified.

#### PLATE XXXVIII. - Fig. 4-8.

#### VITTARIA LINEATA, SWARTZ.

#### Ribbon-Fern. Fillet-Fern.

VITTARIA LINEATA:—Root-stock short, creeping, densely covered with lanceolate-acuminate fuscous-brown scales; fronds clustered, almost sessile, pendent, very narrowly linear, not two lines wide, but from one to three feet long, tapering to both base and apex, smooth and rather fleshy in the living plant, subcoriaceous and longitudinally furrowed when dry; veins consisting of a midvein hidden in the frond, and two parallel intramarginal fertile veins, connected with the midvein by very short oblique distant veinlets; sori nearly as long as the frond, sunken into deep intramarginal furrows; sporangia mixed with abundant contorted ribbon-like filaments; spores smooth, ovoid-reniform.

Vittaria lineata, Swartz, in Schraders Journal (1800) ii., p. 72; Syn. Fil., p. 109.—Schkuhr, Krypt. Gew., p. 93, t. 101, b.—
—Willdenow, Sp. Pl., v., p. 404.—Pursh, Fl. Am. Sept., ii., p. 669.—Fée, 3me Mém., p. 17.—Eaton, in Chapman's Flora, p. 589.—Hooker, Sp. Fil., v., p. 180.—Grisebach, Fl. Brit. W. I. Islands, p. 671.—Fournier, Pl. Mex., Crypt., p. 114.—Garber, in Botan. Gazette, iii., 10, p. 83.

Vittaria angustifrons, MICHAUX, Fl. Bor.-Am., ii., p. 261.

Vittaria Schkuhrii, RADDI, Fil. Brasil., p. 51.

Twinopsis lineata, J. Smith, "in Hooker's Journ. Bot., iv., p. 67." Pteris lineata, Linneus, Sp. Pl., p. 1530.

Lingua Cervina longissimis & angusti:simis foliis, Plumier, Fil. Am., p. 123, t. 143.

Phyllitis lineata, graminis folio longissimo, Petiver, "Fil., p. 126, t. 14, f. 3."

HAB.—In large tufts on the trunks of the Cabbage Palmetto, apparently not uncommon in the southern part of Florida. It was first observed in Florida by Michaux, who found it on the banks of a little stream called *Aisa-hatcha*. It has since been gathered by many collectors, among them LeConte, Buckley, Dr. Palmer, Austin, J. Donnell Smith 1, Dr. Garber, and Miss E. S. Boyd, from all of whom I have specimens. It is found also in Mexico, in the West Indies and in several countries of South America; and, if all the plants referred to this species by Mr. Baker are really the same thing, the range includes also Japan, India and a good part of Africa.

Description.—The entangled and creeping root-stocks form masses of considerable size, often covered with mosses, as Plumier noticed nearly two centuries ago. The scales which are very abundant on the root-stocks, are narrowly lanceolate, and drawn out into a long slender acumination, far finer than hair. They are devoid of midnerve, and are made up of dark amber-brown somewhat cancellated cells; the marginal cells having short slightly curved teeth on their outer side. These teeth are found also on the slender acumination. The whole scale is about two lines long, and only the third part

t Messrs. Smith and Austin found the prothalline growth of this fern very abundant on Palmettos along the Caloosa-hatchie river.

of a line wide at the widest place. The rootlets are covered with a yellowish-brown tomentum.

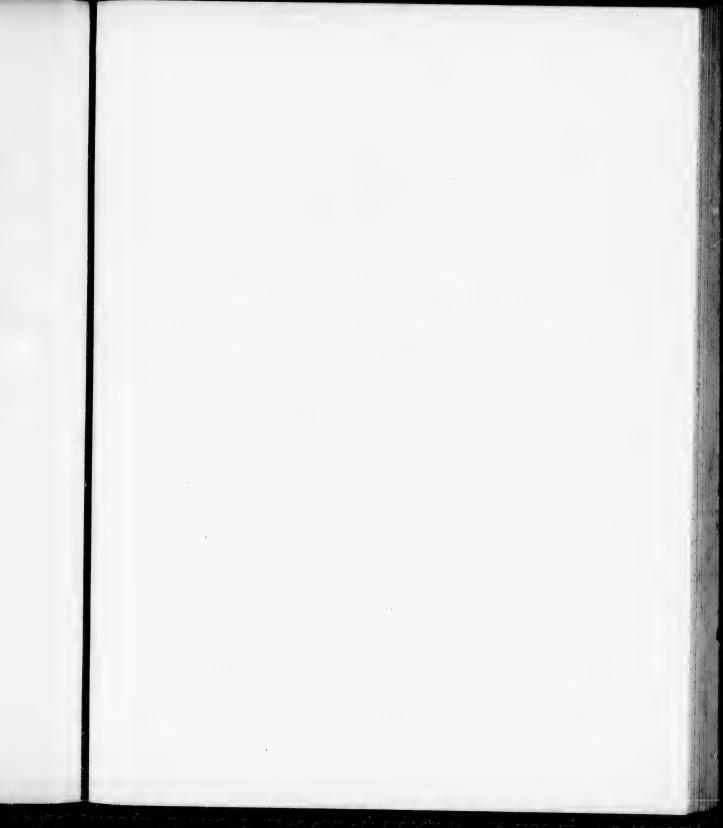
The fronds are densely clustered, pendent in habit, thickish and almost fleshy in texture in the living plant, but more coriaceous when dried. They are sessile, or at most provided with a blackish stalk only a few lines long. They are about a line and a quarter or perhaps a line and a half wide, and of any length, from an inch in young plants up to three feet in mature ones, as observed by Dr. Garber, or a metre, as recorded by Fée. They may therefore be over three hundred times as long as they are wide, a proportion to be found, probably, in no other fern.

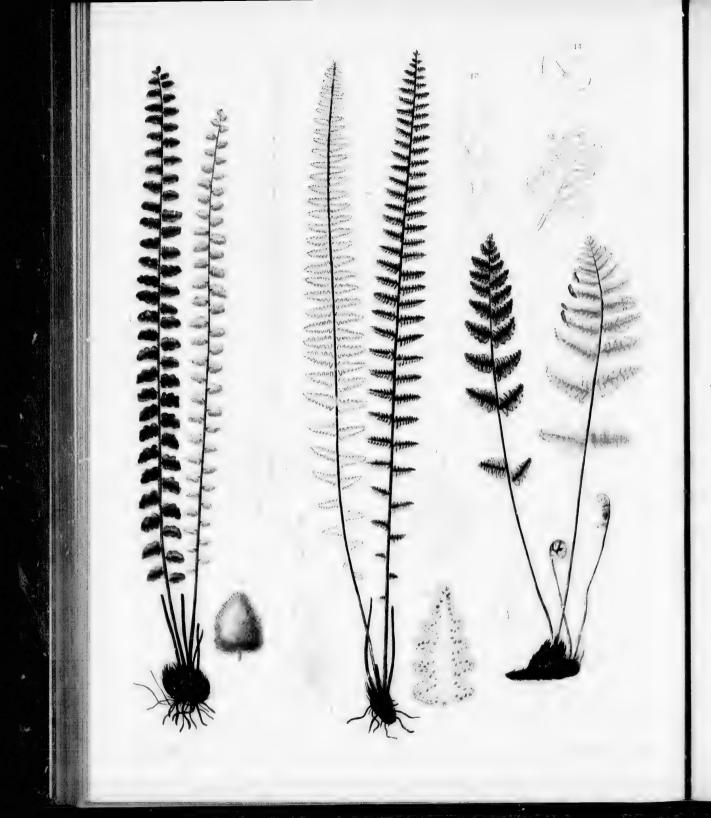
The principal veins are three, and can be seen best by splitting a frond with a very thin and sharp knife. The midvein is completely buried in the parenchyma of the frond. The fertile veins are parallel with it, one on each side, very near the margin, each one nearly reached by a furrow on the under side of the frond. At distant intervals there is a very short oblique veinlet rising from the midvein and connecting it with one or the other of the fertile veins. In very young plants the fronds are thinner and sterile, and the veins can be very easily seen. The edges of the furrows are very thin, and at first meet each other, but are afterwards somewhat separated. At the bottom of each furrow is a continuous line-like sorus, made up of a few sporangia and many curved or contorted sometimes branching filaments, the sporangias-

ters of Fée, which are probably abortive sporangia. In some other species of *Vittaria* these end in a bell or cup, but in this species they are simply a little enlarged at the end. Fée calls them ribbon-like. To me they seem canaliculate along the outside of the longitudinal curve. The sporangia are roundish, and have a ring of about fourteen or sixteen joints. The spores are smooth and ovoid-reniform, as they are in all but two species of the genus.

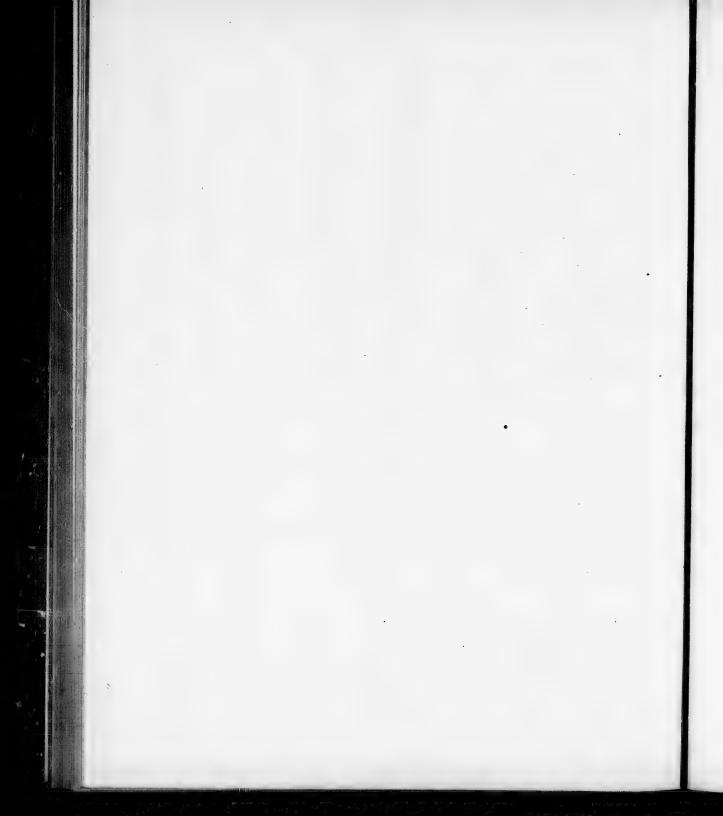
Fée remarks,—"V. lineata is the species longest known, and the one about which there is most vagueness and uncertainty in the descriptions. We believe it to be exclusively American.... We regard as being V. lineata, every kind which grows in a cluster from a root-stock little disposed to advance, having fronds rolled in along their edges in drying, and having then a channelled appearance; with marginal sporothecia inside a fold (repliés en dedans), and with ribbon-like sporangiasters." In our plant the sporothecia or sporangia are intramarginal rather than marginal, but as Fée says the Florida plant is the true V. lineata, it is perhaps fair to suppose that his word "marginal" is not to be understood too literally. Fée gives twenty-five Vittarias, but the authors of the Synopsis Filicum only thirteen.

The plate is drawn from a plant collected by Dr. Edward Palmer near the Indian River. The details show a part of a frond enlarged, and a section of the same; also a spore and a contorted sporangiaster.









## PLATE XXXIX. - Fig. 1-6.

# NOTHOLÆNA SINUATA, KAULFUSS.

# Wavy-leaved Notholæna.

Notholæna sinuata:—Root-stock short and thick, very chaffy with narrow ferruginous scales; stalks short, covered, when young at least, with ciliated scales; fronds six inches to two feet high, rigid, narrowly oblong-linear, simply pinnate; pinnæ numerous, short-stalked, coriaceous, roundish or ovate, often somewhat cordate, obtuse, nearly entire or sinuated or sinuately lobed; upper surface more or less sprinkled with stellate or pinnately divided white scales; lower surface and rachis densely covered with ferruginous ovate or ovate-lanceolate ciliated scales which conceal the sub-marginal sporangia.

Notholæna sinuata, Kaulfuss, Enum. Fil., p. 135.—Kunze, in Linnæa, xiii., p. 135; Die Farrnkraüter, p. 95, t. 45.—Link, Fil. Hort. Berol., p. 145.—Martens & Galeotti, Syn. Fil. Mex., p. 46.—Liebmann, Mex. Bregn., p. 61.—Fée, 8me Mém., p. 117; 9me Mém., p. 12.—Mettenius, Fil. Hort. Lips., p. 45.—Eaton, in Bot. Mex. Boundary, p. 234.—Hooker, Sp. Fil., v., p. 107 (excluding var. bipinnata); "Bot. Mag., t. 4699."—Hooker & Baker, Syn. Fil., p. 370.—Fournier, Pl. Mex., Crypt., p. 120.

Aerostichum sinuatum, Swartz, Syn. Fil., p. 14.—WILLDENOW, Sp. Pl., v., p. 120.

Gymnogramme sinuata, PRESL, Tent. Pterid., p. 219. - METTENIUS, Cheil-

anthes, p. 6.—Kuhn, Beitr. z. Mex. Farnfiora, p. 2.

Notholæna lævis, Martens & Galeotti, Syn. Fil. Mex., p. 46.—Kunze, in Linnæa, xviii., p. 323; xx., p. 417.—Fée, ll. cc.

Notholæna pruinosa, FéE, 8me Mém., p. 78; 9me Mém. p. 12; 10me Mém., p. 20, t. 34, f. 2.

Hab.—On rocks, often much exposed to the sun; from Texas to New Mexico and Arizona, and southward to Peru and possibly Chili. Mr. Wright collected it on the rocky bluffs of Rio Frio, in Texas. Dr. Seguin found it in Garita Cañon, San Andreas Mountains, New Mexico. Dr. Rothrock found it growing on limestone near Camp Bowie in Eastern Arizona, and at Cottonwood in the same Territory, at an elevation of 4,500 feet. The Botanists of the Mexican Boundary Survey collected it at several places in Texas and New Mexico, and Mrs. E. P. Thompson has sent it also, though whether from Arizona or Southern Utah is at present doubtful. The writers on Mexican Ferns name many stations for it, on limestone, trachyte, conglomerate, in crevices of lava, and on walls, assigning to it a vertical range from 2,000 to 7,000 feet above the sea.

Description:—The root-stock is rather short, creeping, and swollen in places into "bulbiform knobs as large as hazelnuts." It is very densely clothed with narrow acuminate rather rigid but slightly sinuous ferruginous scales. The stalks are a few inches long, bright reddish-brown, round and wiry, and clothed at the very base with chaff like that of the root-stock. The rest of the stalk and the rachis have a somewhat deciduous covering of very delicate lanceolate scales of two kinds intermixed; larger ones which are but slightly ciliated, and smaller ones very deeply and elegantly ciliated.

The fronds, exclusive of stalk, are from six inches to nearly two feet high, erect and rigid, coriaceous in texture, narrowly oblong-linear in outline, and simply pinnate. pinnæ vary in length from two or three lines to three-fourths of an inch, or possibly more, and in width from two to six lines. There are from twenty to thirty or more each side of the rachis, all alike except the uppermost, which are smaller, and pass gradually into the short pinnatind apex of the frond. In small fronds the pinnæ are roundish and slightly crenated: in larger fronds they are more ovate, and have sinuated margins; and in the largest they are cordate-ovate, and sinuately lobed half-way to the midvein. The under surface is thickly covered with appressed and inbricated, ovate or lanceolate, pectinately ciliated or radiately multifid scales; the upper surface bears scattered pectinate or stellate scales, which appear to be sometimes lacking, and the plant is then var. integra of Liebmann, the N. lævis of Martens & Galeotti. The scales of the upper surface are white; those of the under surface are commonly cinnamon-brown in the middle, and white around the edges. Occasionally, and probably through either immaturity or over-maturity, the under scales are nearly white throughout, and it is on plants in this condition that Fée founded his N. pruinosa, made a variety by Fournier. Rarely the under scales are ciliated only at the base, and only denticulate along the sides.

The veins are very obscure, being not only hidden under the scales, but buried in the coriaceous pinnæ. They seem to be crowded, and nearly straight, the upper part thickened a little and fertile, making the sori somewhat elongated on the upper part of the veins. The spores are irregularly spheroid-tetrahedral, the surface very rough, and of a dingy yellowish-brown. Mettenius and Kuhn, following the example of Presl, referred this species to *Gymnogramme* rather than *Notholæna*, since the sori follow the veins almost too far down their tips to accord well with the latter genus; but its nearest relatives seem to be in *Notholæna* rather than in *Gymnogramme*.

Plate XXXIX., Fig. 1-6.—Notholæna sinuata. Fig. 1 is a plant of medium size, having ovate and sinuated pinnæ. Fig. 2 represents three pinnæ of the largest form. Fig. 3 is a frond of the smallest form. Fig. 4 is a pinna from Fig. 1, enlarged and showing the chaffy lower surface. Fig. 5 is a scale from 4, magnified. Fig. 6 a spore highly magnified,

## PLATE XXXIX. - FIG. 7-10.

# NOTHOLÆNA FERRUGINEA, DESVAUX.

## Rusty Notholæna.

Notholæna ferruginea:—Root-stock creeping, knotted with bud-like frond-bearing branchlets, and densely covered with narrow blackish rigid scales; stalks a few inches high, tufted, wiry, dark-brown, woolly, like the rachis, with sometimes deciduous rusty fibres; fronds linear-lanceolate, five to twelve inches long, usually less than one inch wide, erect, sub-coriaceous, pinnate; pinnæ numerous, oblong-ovate, almost sessile, pinnatifid into six or eight close-set little oblong lobes on each side, grayish-villous above, heavily tomentose beneath with entangled whitish or ferruginous woolly hairs; sporangia at the ends of the veins, at length showing through the tomentum, often very dark brown or even black.

Notholæna ferruginea, Desvaux, "Journ. Bot. Appl., i., p. 92."—Hooker, Second Century of Ferns, t. lii; Sp. Fil., v., p. 108.—Hooker & Baker, Syn. Fil., p. 370.—Fournier, Pl. Mex., Crypt., p. 120.—Eaton, Ferns of the Southwest, p. 306.

Cheilanthes ferruginea, Willdenow, "Herb."— Kaulfuss, Enum. Fil., p. 209.—Link, Fil. Hort. Berol., p. 65.—Mettenius, Cheilanthes, p. 23.

Pellæa ferruginea, NEES, in Linnæa, xix., p. 684.

Cincinalis ferruginea, Desvaux, in Mag. d. Gesellsch. Nat. Freund. z. Berlin, v. (1811), p. 311 (The original name).

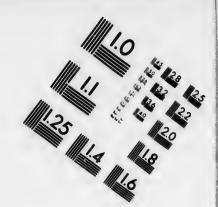
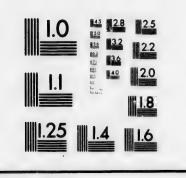


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Notholana rufa, Presl, Reliq. Haenk, i., p. 19.—Kunze, in Linnæa, ix., p. 55; xiii., p. 135; xviii., p. 324.—Martens & Galeotti, Syn. Fil. Mex., p. 45.—Liebmann, Mex. Bregn., p. 62.—Eaton, in Bot. Mex. Boundary, p. 234.

HAB.—Collected in the Survey of the Mexican Boundary in rocky places along the Rio San Pedro and Rio Grande, in Texas, and in the Organ Mountains of New Mexico. Sanoita Valley, Arizona, Professor ROTHROCK. Not rare in Mexico, found growing on calcareous and various kinds of igneous 200-ks, and on the ground. Also seen in Jamaica, and in Guatemala, Venezuela, Columbia, Ecuador and Peru.

DESCRIPTION: - The root-stock is a few inches long, and perhaps a little thicker than a crow-quill. Along the lower side it has long fibrous roots, and on the upper it is said by Hooker to produce "bulbiform scaly buds which are frondiferous." My specimens, unfortunately, have too scanty a root-stock to show this very clearly. The scales are very abundant, but only about a line long: they are lanceolatesubulate, very rigid, and consist of a strong nearly black midnerve, bordered along its lower half by a narrow transparent cellular membrane, slightly denticulate along the edges. The stalks are erect, two to six inches long, terete, wiry, and very dark brown in color. Like the rachis, they are at first covered with fine pale-brown or rusty woolly fibres; but this covering is apt to be worn off in mature specimens. The section of the stalk shows a very thick and dark external sheath, and in the middle a butterfly-shaped fibro-vascular bundle.

The fronds in Professor Rothrock's Arizona specimens are from five to ten inches long, and six to nine lines wide. A very fine frond, collected in Chiapas by Dr. Ghiesbreght, is over a foot long, and a little more than an inch wide. The fronds are linear-lanceolate in shape, moderately acute at the apex, and taper slightly from near the middle to the base. The pinnæ are from twenty-five to forty on each side, in general oblong-ovate, broadest at the very short-stalked base, the lower ones often half an inch apart, but the upper ones crowded, and sometimes even overlapping. They are lobed about half-way to the midvein into from six to nine or ten little oblong, somewhat rounded, lobes on each side. The upper surface of the pinnæ is greenish-gray, from a fine villous pubescence: the lower surface has a dense covering of very fine entangled woolly hairs, which are sometimes nearly white, at other times light ferruginous-brown, and, again, of a deep-brown color. Kunze (in Linnæa, xviii., p. 324) seems to be of the opinion that the color of the tomentum is paler in young fronds than in mature ones, and analogous differences in the color of the scales or of the tomentum in some other ferns would strengthen this view. but the matter is not yet fully proved.

The sporangia are borne just at the ends of the veins, and the margin of the lobes is slightly recurved, as if making a feeble attempt to form an involucre. The plant was first described as a *Cincinalis*, then as *Notholana* and then as *Cheilanthes*, and is now again usually considered a *Noth-*

olæna, but, as Sir W. J. Hooker remarks, "it has nearly as good a claim to rank with the one genus as with the other. The sporangia have been described as quite black, but they are often not much deeper in color than the tomentum in which they are embedded. The spores are globular, dark resinous-brown, and very large.

There is no other fern in the United States, with which this need be confused. From N. sinuata, apart from the difference in the shape of the pinnæ, it is abundantly distinguished by the nature of the covering of the pinnæ, scaly in that species, and finely tomentose in this. The other woolly or tomentose Notholænas found within our limits have thrice or four times pinnate fronds, very unlike those of N. ferruginea. The Chilian N. hypoleuca comes much nearer to it, but has a blacker stalk, a shorter frond, and more deeply pinnatifid pinnæ, nearly smooth above, and matted with pure-white or pale-ferruginous very fine tomentum beneath.

Plate XXXIX., Fig. 7-10.—Notholana ferruginea.—Fig. 7 is a plant with two fronds; Fig. 8, a pinna enlarged and showing the sporangia; Fig. 9, a little of the tomentum or wool, highly magnified; Fig. 10, a spore.

## PLATE XXXIX.-Fig. 11-14.

### NOTHOLÆNA NEWBERRYI, D. C. EATON.

## Newberry's Notholæna.

Notholæna Newberry: — Root-stock creeping, covered with very narrow dark-brown subulate scales; stalks clustered, three to six inches long, slender, blackish-brown, at first woolly with a pale-ferruginous tomentum; fronds as long as the stalks, lanceolate-oblong, covered, most densely beneath, with a web of very ûne entangled whitish hairs, tri-quadripinnate; pinnæ triangular-ovate, the lowest ones rather distant, but not reduced in size; ultimate segments crowded, roundish-obovate, one-third to one-half a line wide, entire or slightly crenate; sporangia rather large, blackish, at length emergent from the tomentum.

Notholana Newberryi, Eaton, in Bulletin of Torrey Botan. Club, iv., p. 12; Ferns of the Southwest, p. 307.—Baker, Syn. Fil., ed. ii., p. 515.

HAB.—Southern Counties of California, often among dry and exposed rocks. Discovered near San Diego by Professor J. S. Newberry, November 9, 1857, and since gathered near that city by Professor Wood, Mr. CLEVELAND and others. Abundant in the Temescal Range, Professor Brewer. Near San Bernardino, Dr. Palmer. The finest specimens I have seen were collected near Poway, about seventeen miles northward of San Diego, by Mr. WILLIAM STOUT.

DESCRIPTION:—Root-stocks creeping, more or less branched, matted together and covered with minute blackish-brown subulate rather rigid scales. The stalks are mostly about four inches long, erect, slender, wiry, very dark-brown and at length smooth and polished, though at first covered with a rusty-whitish wool. The section is round, and shows a single roundish fibro-vascular bundle in the middle.

The fronds are about as long as the stalks, and an inch to nearly two inches wide, lanceolate-oblong in shape, and whitened on both surfaces with a web of very fine entangled hairs. This covering is very heavy on the under surface, but so thin on the upper that the green color of the frond may be seen through it. In young fronds it is creamy-white, but as the fronds mature it gradually deepens into a pale rusty brown. The fronds are fairly tripinnate, and a few or the pinnules nearest the midrib are often again divided, so as to render the frond sub-quadripinnate. The primary pinnæ are from half an inch to an inch long, and are triangular-ovate in shape, the lower ones being broader and more remote than the rest. The ultimate segments are very minute, roundishobovate, and much crowded, just as in the species of *Cheilanthes* of the section *Myriopteris*.

In fertile fronds the sporangia form a blackish line around the edge of the segments, which are perfectly flat, and have not even the suggestion of an involucre. The sporangia are so few as to form but a single marginal row, and are, when fully ripe, blacker than in any other North American fern. They are twice the size of the sporangia of *Polypodium vulgare*, globular, and almost sessile. The ring has about fourteen or sixteen articulations, and the cells of the *stoma*, or place where the sporangium opens, are very long and narrow. The spores are also very large, and very dark-colored: they are globular, slightly roughened, and marked with three faint radiating vitte.

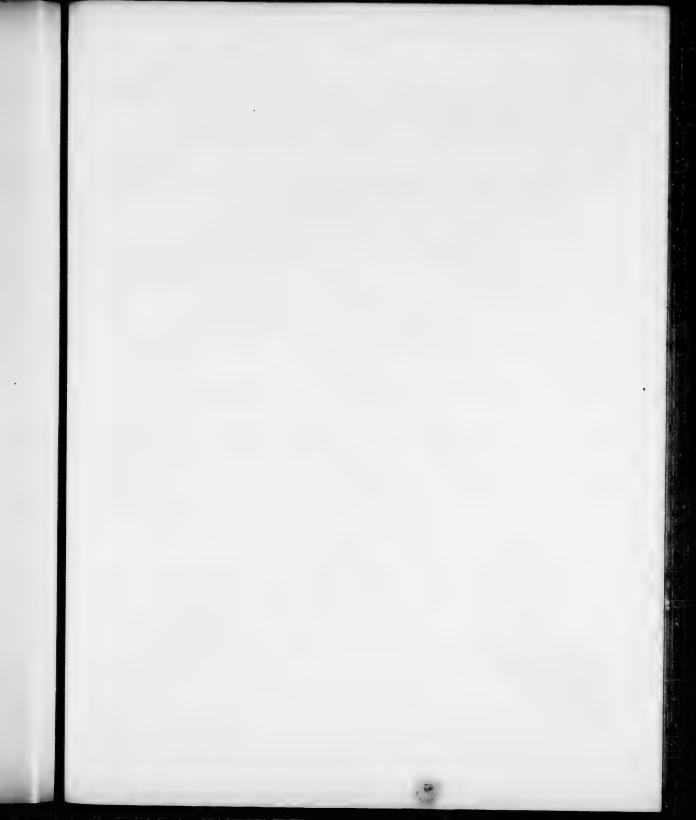
This fern has very much the appearance of *Cheilanthes tomentosa*, but is whiter, more webby than woolly, and differs generically in the absence of an involucre. *Notholæna Parryi*, to be figured in a later number of this work, is a much smaller plant, and has a much coarser pubescence. *N. mollis*, from Chili, has also some resemblance to it, but in that plant the ultimate pinnules are less crowded, and the heavier, and deep-colored tomentum is stellated in its structure.

The genus Notholæna contains in all about three dozen species, the greater part South American, but two are South European, and a few African, Indian or Australasian. Within our limits are nine or perhaps ten species, of which four have the fronds coated beneath with yellow or white ceraceous powder, and belong to the section Cincinalis. The rest are either scaly or woolly beneath, except N. tenera; cf Gillies, which has a smooth frond.

Notholæna Aschenhorniana, of Klotzsch, is attributed to "Texas and Mexico" in Synopsis Filicum. I have never seen any specimens of this species, and hope that some of

our Botanists in Texas or New Mexico may be so fortunate as to find it. It is described as having a tripinnatifid frond eight to twelve inches long, linear-oblong crenate or pinnatifid segments, and has the lower surface matted with ciliated ferruginous scales, beneath which are "minute reddish apparently resinous dots."

Plate XXXIX, Fig. 11-14.—Notholana Newberryi. Fig. 11 is a plant with two fronds. Fig. 12 shows a few of the woolly hairs, magnified. Fig. 13 is a pinnule, stripped of the wool, and showing the sporangia, also magnified. Fig. 14, a spore.









### PLATE XL.

### ASPIDIUM GOLDIANUM. HOOKER.

#### Goldie's Wood-Fern.

ASPIDIUM GOLDIANUM:—Root-stock stout, ascending, chaffy; stalks about a foot long, chaffy at the base with large ovate-acuminate ferruginous or deep-lustrous-brown scales; fronds standing in a crown, one to two and a half feet long, broadly ovate, or the fertile ones oblong-ovate, chartaceo-membranaceous, nearly smooth, bright-green above, a little paler beneath, pinnate; pinnæ broadly lanceolate, five to eight inches long, one to two and a half broad, usually, especially the lowest ones, narrower at the base than in the middle, pinnatifid almost to the midrib; segments numerous, oblong-linear, often slightly falcate, crenate, or serrate with sharp incurved teeth; veins free, mostly with three veinlets, the lowest superior veinlets bearing near their base the large sori very near the midvein; indusium large, flat, smooth, orbicular with a narrow sinus.

Aspidium Goldianum, Hooker, in Goldie's Acc. of rare Canad. Pl. in Edinb. Phil. Journ., vi., p. 333; Fl. Am.-Bor., ii., p. 260.—
Torrey, Fl. New York, ii., p. 495.—Gray, Manual, ed. ii., p. 598, ed. v., p. 666.—Mettenius, Fil. Hort. Lips., p. 92;
Aspid., p. 56.—Williamson, Ferns of Kentucky, p. 95, t. xxxiv.

Nephrodium Goldianum, Hooker & Greville, Ic. Fil. t. cii.—Hooker, Sp. Fil., iv., p. 121.—Hooker & Baker, Syn. Fil., p. 272.

Lastrea Goldiana, PRESL, Tent. Pterid., p. 76.—LAWSON, in Canad. Nat. i., p. 282.

Dryopteris Goldiana, GRAY, Manual, ed. i., p. 631.

Aspidium Filix-mas, Pursh, Fl. Am. Sept., ii., p. 662.

HAB.—Deep, rocky woods, from Canada and Maine to Indiana, Virginia and Kentucky. It is also named in local catalogues of the flora of Wisconsin and Kansas. Not known in the Old World.

DESCRIPTION: — The root-stock is creeping or ascending, several inches long, and nearly an inch thick. This thickness is made up, in considerable part, by the adherent bases of old stalks; the stalks being perfectly continuous with the rootstock, and so much crowded as to overlap each other. When fresh the root-stock is fleshy, and a longitudinal section of it shows that its substance passes so gradually into that of the stalk-bases, that no point of separation or distinction between the two can be selected. This kind of root-stock is found also in Aspidium spinulosum and its allies, in A. Filix-mas, A. cristatum, A. marginale, A. Nevadense, A. fragrans, and A. rigidum, and in very many exotic species, and it is very unlike the root-stocks of A. Thelypteris, A. Noveboracense, and A. unitum, species which have been already described and figured in the present work. The parenchymatous portion of the root-stock is loaded with starch in very minute grains, as may be easily proved by adding a drop of alcoholic solution of iodine to a thin slice of the root-stock placed

under a microscope, when the grains will be presently seen to turn blue, the recognized sign of starch. This abundance of nutritive material in the root-stock enables it to send up a fine circle of large fronds in the proper season of the year.

The stalks are from nine to fifteen inches long, rather stout, green when living, but straw-color when dried for the herbarium, in which condition they are furrowed in front and along the two sides. At the base they are covered with large ovate-acuminate brown or sometimes dark and shining scales. Mixed in with these are smaller and narrower chaffy scales, which also are found along the whole length of the stalk and the rachis. The cross-section of the stalk shows two rather large roundish fibro-vascular bundles on the anterior side, and three, the middle one largest, at the back.

Several fronds are usually seen growing from a root-stock, those produced early in the season commonly sterile, and shorter than the others. The full-grown and fertile fronds are often two feet or two and a half feet long, and about one foot broad. The general outline is oblong-ovate, the lowest pinnæ being scarcely, if at all, shorter than those in the middle of the frond. There are usually about eight or ten full-sized pinnæ each side of the rachis, besides the gradually diminishing pinnæ near the acute pinnatifid apex. The larger pinnæ are from five to eight inches long, the middle ones an inch or an inch and a half wide, but the lowest ones two inches and a half broad. The greatest breadth of the pinnæ is usually near the middle or even a little above the middle,

so that they are slightly narrowed towards the base; and in this character lies one of the readiest distinctions between this fern and those large forms of *A. cristatum*, which have occasionally been mistaken for *A. Goldianum*; for in that other species the greatest breadth of the pinnæ is uniformly at the base.

The segments of the pinnæ are from fifteen to twenty each side the midrib: the incisions do not extend quite to the midrib, so that the latter is narrowly winged, and the pinnæ are pinnatifid rather than pinnate. The segments are from nine to eighteen lines long, and about three lines wide: they are set rather obliquely on the midrib, and are often slightly curved upwards, or falcate. They are obtuse or somewhat acute, and have the edges crenate, or more or less distinctly serrate with sharp incurved teeth.

The veins are free, and are pinnately forked into from three to five slender oblique veinlets, of which the lowest one on the upper side is the longest, and bears a fruit-dot near its base. The fruit-dots are seldom or never found on the two or three lowest pinnæ, but on the rest they are arranged in a row each side the midveins of the segments, and much nearer the midveins than the margins. There are in all from ten to twenty to a segment.

The indusia are larger than in most of the related species, flat, perfectly smooth, orbicular with a very narrow sinus, and slightly erose-crenulate on the margin. In the second edition of Gray's Manual it is said that the indusium is "often"

orbicular without a distinct sinus, as in *Polystichum*;" and it is sometimes difficult to see the sinus, but I think it is rather because the sides of it overlap than because there is none. The sporangia have a ring of from fifteen to twenty articulations. The spores are ovoid, and somewhat roughened on the surface.

This fern is one of the very finest and largest of the species of the Eastern States, being surpassed in these respects only by the osmundas and the ostrich-fern. The fronds are smooth, deep-green in color, slightly paler beneath, and of a rather firm papery texture. Unlike A. Filix-mas and A. cristatum the fronds wither in the fall of the year, and are not "half-evergreen."

It was collected by Pursh on his visit to America in the early part of this century, the precise locality not known,—in the Flora he says "New Jersey to Virginia,"—and was by him referred to A. Filix-mas. His specimens, preserved in the herbarium at Kew, are partly A. Goldianum and partly A. cristatum. Mr. John Goldie's discovery was made near Montreal, about the year 1818, and the excellent figure in Hooker & Greville's Icones Filicum was probably taken from one of his specimens, or perhaps from live plants originally brought by him to the Botanic Garden at Glasgow.

Though not one of our commonest Ferns, this is very abundant in certain localities:—Mrs. Roy sends it from Owen Sound, Canada; Dr. Bumstead got it in Smuggler's Notch, Mt. Mansfield, Vermont; Mr. Frost has a fine station on Mt.

Wantastiquet, New Hampshire; I find it plentiful and fine in the deep ravine called Roaring Brook, in Cheshire, Connecticut; Professor Porter has it from Burgoon's Gap, in the Alleghany Mountains of Pennsylvania; Mrs. McCall, near Madison, Ohio; Mr. Williamson "found it in great abundance near the Little Rockcastle River, in Laurel County," Kentucky, and Mr. Curtis has twice sent me fine specimens, with very dark scales at the base of the stalks, from the Peaks of Otter, Virginia.

The name is sometimes written Goldieanum; I give the name as it occurs in Goldie's original paper in the Edinburgh Philosophical Journal.

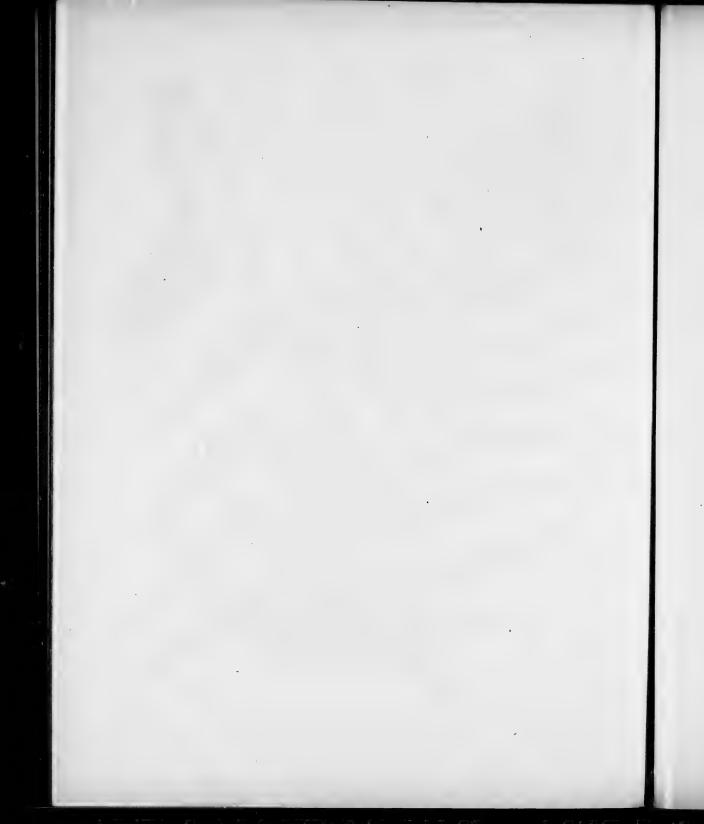
The specimen drawn by Mr. Faxon is from Vermont, and is represented about two-thirds of the natural size. The details show the nature of the venation, an indusium, etc.





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#### PLATE XLI.

# ASPIDIUM FILIX-MAS, SWARTZ.

#### Male Fern.

ASPIDIUM FILIX-MAS: - Root-stock short, stout, ascending or erect; stalks rarely over a foot long, very chaffy with large lanceolate-acuminate scales and smaller ones intermixed; fronds standing in a crown, one to three feet long, half-evergreen, firm-membranaceous, broadly oblong-lanceolate, slightly narrowed toward the base, pinnate or sub-bipinnate; pinnæ lanceolate-acuminate from a broad base, pinnatifid almost or rarely quite to the midrib; segments smooth and full-green above, slightly paler and bearing a few little chaffy scales beneath, normally oblong, obtuse or even truncate, slightly toothed, in another form ovate-lanceolate, acutish and pinnately incised; veins free, forked or pinnately branched into from two to five veinlets; sori rather large, nearer the midvein than the margin, commonly occurring only on the lower half or two-thirds of each segment; indusia convex when young, rather firm, smooth or minutely glandular, orbicular-reniform.

Aspidium Filix-mas, Swartz, in Schraders Journal, ii., (1800) p. 38; Syn. Fil., p. 55.—Schkuhr, Krypt. Gew., p. 45, t. 44.— Willdenow, Sp. Pl., v., p. 259.—Link, Fil. Hort. Berol., p. 105.—Ruprecht, Distr. Krypt. Vasc. in Imp. Ross., p. 35.— Kunze, in Sill. Journ., July, 1848, p. 83.—Mettenius, Fil. Hort. Lips., p. 92; Aspidium, p. 55.—Eaton, in Gray's Manual, ed. v., p. 666.—Milde, in Nov. Act. Acad. Nat. Cur., xxvi., ii., p. 507; Fil. Eur. et Atl., p. 118.—Miquel, Prolusio Fl. Jap., p. 117.

Polypodium Filix-mas, LINNÆUS, Sp. Pl. p. 1551.

Polystichum Filix-mas, Rотн, "Fl. Germ., iii., p. 82."—Косн, Syn. Fl. Germ. et Helv., ed. iii., p. 733.

Nephrodium Filix-mas, Richard, "in Desvaux, Mém. Soc. Linn., vi., p. 60."—Hooker, Brit. Ferns, t. 15; Sp. Fil., iv., p. 117.—Hooker & Baker, Syn. Fil., p. 272 (excl. vars. 7 and 8).

Dryopteris Filix-mas, Schott, Gen. Fil.—Newman, Hist. Brit. Ferns, ed. iii., p. 184.

Lastrea Filix-mas, Presl, Tent. Pterid., p. 76.—Moore, Brit. Ferns, Nat. Pr., t. xiv, xv, xvi, xvii.

Var. incisum, METTENIUS:—Frond ample, two to three feet long, scantily chaffy on the rachis; segments rather distant, lanceolate, tapering to a sub-acute point, incised on the margins with serrated lobules; indusium rather delicate, in age shrivelling or falling off.—Aspidium, p. 55; MILDE, Fil. Eur. et Atl., p. 120.—Lastrea Filix-mas, var. incisa, Moore, l.c.—Nephrodium Filix-mas, var. affine, Hooker & Baker, l.c.

Var. paleaceum, Mettenius:—Frond ample, two to three feet long, stalk and rachis very chaffy with ferruginous or blackish scales; segments oblong, truncate, nearly entire on the margins; indusium coriaceous, the edges much incurved, sometimes splitting in two.—Aspidium, p. 55; MILDE, Fil. Eur. Atl., p. 121.—Lastrea Filix-mas, var. paleacea, Moore, l.c.—Aspidium paleaceum, Don, "Prodr. Fl. Nepal., p. 4;" Fournier, Pl. Mex., Crypt., p. 92. Aspidium parallelogrammum, Kunze,

in Linnæa, xiii., p. 146, etc.—Nephrodium Filix-mas, var. parallelogrammum, Hooker, Sp. Fil., iv., p. 116.—Dichasium parallelogrammum and D. patentissimum, Fée, Gen. Fil., p. 302, t. xxiii, B.—Lastreatruncata, Brackenridge, Fil. of U. S. Expl. Exped., p. 195, t. 27 (admirable).

HAB.—In one form or another, this species occurs in America from Greenland to Peru, throughout Europe and Asia, in parts of Africa, and in many islands of the ocean. The ordinary European form corresponding to Moore's plate XIV has been collected in British Columbia by Dr. LVALL, in Keweenaw Peninsula of Northern Michigan by Dr. Robbins, and in the mountains of Colorado by Messrs. HALL & HARBOUR and Mr. Brandegee. Var. incisum was found at the base of calcareous rocks at Royston Park, Owen Sound, Ontario, Canada, by Mrs. Roy, and in the mountains of Colorado by Dr. Scovill, for one of whose specimens I am indebted to D. A. Watt, Esq., of Montreal. Fragments of apparently the same form have been received from Dakota. The Californian plant mentioned in Plantæ Hartwegianæ, p. 342, is better regarded as a form of Aspidium rigidum. Var. paleaceum has not been found in either Canada or the United States, but is well known in Mexico, in Europe, in Southern Asia, in the Hawaiian Islands, etc.

DESCRIPTION:—This fern has a stout, usually ascending, but sometimes erect, very chaffy root-stock, very much like

<sup>&</sup>lt;sup>1</sup> Milde indicates several other unimportant variations; and Hooker & Baker have as varieties of this species the East Indian Aspidium cochleatum, and Aspidium clongatum, from Madeira and the Canary Islands. The latter they give as occurring also in the southern United States, evidently supposing it to be the long-lost A. Ludovicianum of Kunze. For abundant synonymy of Aspidium Filix-mas the student is referred especially to the works of Hooker, Milde, Mettenius and Moore, as quoted above.

that of the species last described. It sometimes rises a little above the surface of the ground, forming a short trunk.

The stalks seem to vary a good deal in length, being sometimes only two or three inches long, and at other times over a foot. They are clustered at the growing end of the root-stock, and their bases, which remain long after the rest has perished, are consolidated with the root-stock. The stalks are always more or less chaffy, the chaff mainly confined to the lowest portion in some plants, and in others following the stalk and the rachis to the apex of the frond. The largest scales are sometimes fully an inch long. They are narrowly lanceolate-acuminate, distantly ciliate-denticulate on the margin, and composed of narrow but somewhat sinuous cells. Mixed in with them are smaller scales, from two to four lines long, and more distinctly ciliate-toothed. The color of the scales is different in different specimens, varying from bright goldenbrown to ferruginous-brown with a darker spot at the base, and from this to nearly black, especially in the sub-tropical and tropical forms of var. paleaceum. Such specimens are sometimes fairly shaggy with the abundance of scales, which are also found, decreasing in number and in size, on the midribs of the pinnæ, and even on the lower surface of the segments. The usual number of fibro-vascular bundles is seven.

The fronds are broadly lanceolate or oblong-lanceolate in outline, usually narrowed a little, or even conspicuously narrowed, at the base, and acute or acuminate at the apex. They are of a full herbaceous green above, a little paler beneath, and of a rather firmly membranaceous, or, in tropical forms, of a sub-coriaceous texture. Their average length is from one to two feet, but fronds three feet long are occasionally seen; and one very fine example of var. paleaceum, collected in Chiapas, Mexico, by Dr. Ghiesbreght, is three feet and a half long, exclusive of the stalk.

The pinnae are sometimes very numerous; as many as forty on each side have been counted on very large fronds, but the number is more commonly less than twenty. They are lanceolate-acuminate in shape, tapering from a broad base to a slender point; in the common form their average breadth at the base is half to three-fourths of an inch, but in var. incisum they are often fully two inches broad at the base. Their length is from three or four inches in the common form to six or seven inches in the largest specimens I have seen. The midrib of the pinnæ is always more or less winged, so that the pinnæ may be said to be pinnatifid, and the segments to be connected by a narrow wing.

The shape of the segments differs in the several varieties; in the type they are very close together, oblong, with a rounded apex, and not very deeply toothed: in var. paleaceum they are also closely-placed, and oblong, but mostly truncate at the apex; and in var. incisum they are much larger and less closely-placed, ovate-lanceolate in shape, and incised with toothed lobes along the sides.

The veins are free, and are forked or alternately divided

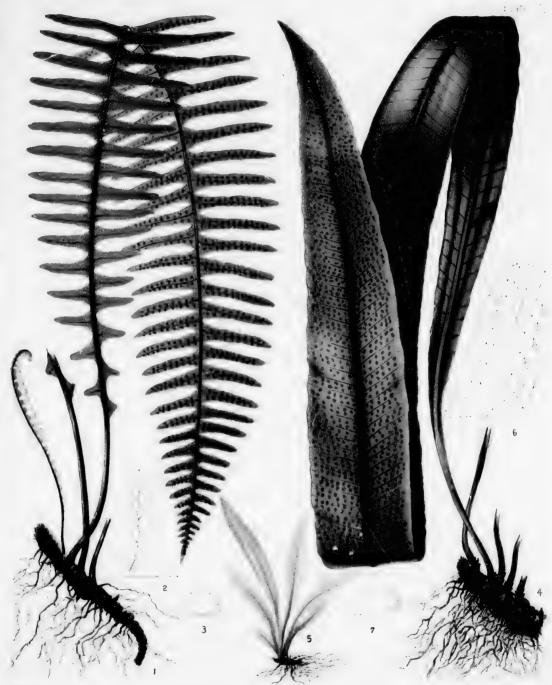
into from two to five veinlets. The sori are rather large, placed nearer the midvein than the margin, and are rarely produced towards the apex of the segments.

The indusium is orbicular-reniform, and almost always smooth. Its edges are turned downward, enclosing the sporangia, when they are young, and sometimes this convexity is permanent. Rarely the sinus is so deep that the indusium at last becomes divided. The spores are ovoid, and have a muricately roughened surface.

The rhizomes have been used for ages as an anthelmintic, but probably have no greater virtue in this direction than those of many other common species.

Plate XLI.—Aspidium Filix-mas, var. incisum. The figure is reduced one-third, and is taken from one of Mrs. Roy's fine Canadian specimens. Other fronds from the same locality show the incising of the segments in a much greater degree. At the top of the plate are two segments enlarged, one from the base and the other from the middle of the same pinna. The indusium is also represented.

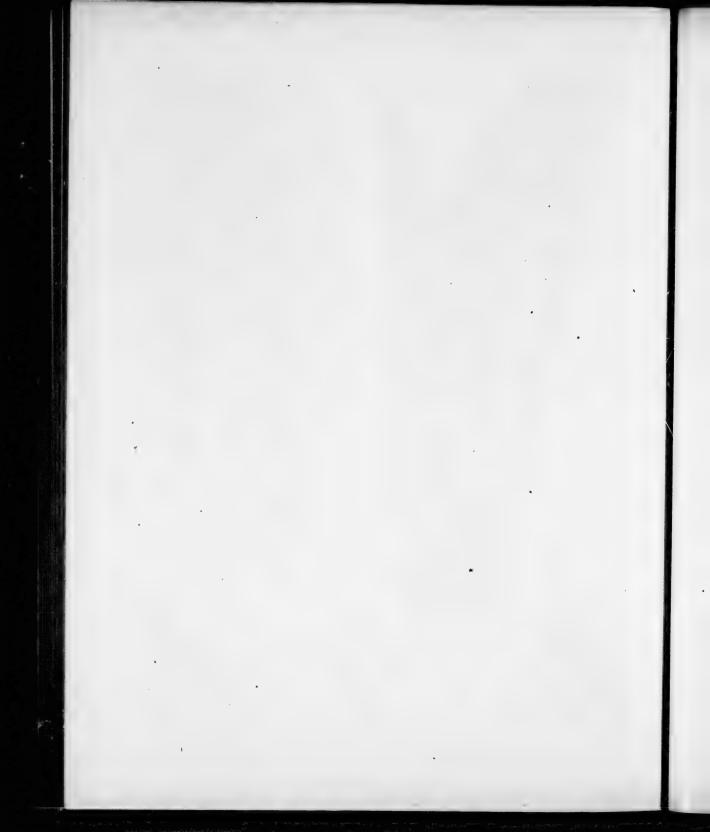




CE haxin, i.

American X Course Spire





### PLATE XLII. - FIG. 1-3.

# POLYPODIUM PECTINATUM, LINNÆUS.

### Comb-leaved Polypody.

POLYPODIUM PECTINATUM:—Root-stock stout, elongated, moderately chaffy and often ferruginous-tomentose; stalks a few inches to nearly a foot long, rigid, blackened and puberulent; freed one to three feet long, two to five inches wide, linear-lanceolate, somewhat curved and elastic when dry, pinnatifid almost to the midrib; segments very numerous, spreading, one to three inches long, two to four lines wide, gradually tapering from a dilated base to a narrow but obtuse apex, usually entire; midvein strong, blackish; veins dark at the base; veinlets three or four in each group, pellucid and nearly invisible, normally free; sori often slightly oval, placed in a single row each side the midvein about half way between it and the margin; spores ovoid-reniform, yellowish, the surface finely pustulated.

Polypodium pectinatum, Linnæus, Sp. Pl., p. 1545.—Swartz, Syn. Fil., p. 34.—Willdenow, Sp. Pl., v, p. 180.—Eaton, Fil. Wright. et Fendl., p. 198.—Hooker, Garden Ferns, t. 10; Sp. Fil., iv, p. 203.—Grisebach, Fl. Brit. W. I. Islands, p. 699.—Hooker & Baker, Syn. Fil., p. 333.

\*\*\* The following names are referred to this species by Hooker, and I do not see how they can be separated from it; but it should be

remarked that METTENIUS and FOURNIER keep them distinct, and that the latter author is of the opinion that our Fern is not the plant LINNÆUS had in view.

- Polypodium Otiles, Linnæus, Sp. Pl., p. 1545.—Swartz, Syn. Fil., p. 34.—Willdenow, Sp. Pl., p. 177.
- Polypodium Paradiseæ, Langsdorff & Fishcher, Ic. Fil., p. 11, t. 11.—Willdenow, Sp. Pl., v, p. 179.—Mettenius, Fil. Hort. Lips., p. 31; Polypodium, p. 60.—Eaton, Fil. Wright. et Fendl., p. 198.
- Polypodium consimile, METTENIUS, in Eaton, Fil. Wright. et Fendl., p. 198; "Prod. Fl. Nov.-Gran., p. 61."—FOURNIER, Pl. Mex., Crypt., p. 76.
- Goniophlebium pectinatum, J. Smith, Bot. Voy. Herald, p. 230 (a form with the veinlets anastomosing in paracostal areoles).
- Polypodium nigrum, tenuius sectum, Plumier, Fil. Am., p. 64, t. 83.

HAB.—Southern Florida; near Enterprise, Mr. C. E. FAXON, at Manatee, Dr. A. P. GARBER.<sup>I</sup> Very common in West Indies, Mexico, and South America as far as Brazil and Paraguay.

DESCRIPTION: — The root-stock is creeping, fleshy in the living plant, covered near the growing end with very narrow slender-pointed scales, which are often in turn concealed by an abundant growth of entangled cinnamon-colored flattened

I "In this locality it is restricted to a small area of high banks of a stream in a hummock draining a series of ponds. The soil is mostly clay intermixed with a small per cent. of sand and vegetable matter. On the sides of the high banks and near the water's edge, apparently in pure clay and rocks, the fronds are narrower, more rigid and erect, while upon the banks and a little distance from the water they are wider, flaccid, and generally reclining. All the fronds appeared fertile, and measured 2 to 4 inches in width, and 1-2 to 8 feet in length."—Dr. Garber, in Botanical Gazette, Oct., 1878, p. 82.

hairs. The stalks are borne on the upper side alternately in a double row, and leave, after they have fallen off, very distinct cup-like scars. The stalks are from one to two lines thick, and from two inches to nearly a foot long, rigid, terete, and nearly black in color, but lustreless. They are puberulent with slender whitish or rusty hairs, and are bordered by a very narrow herbaceous wing on each side for a considerable distance below the proper beginning of the frond. The exterior sheath of the sclerenchyma is very hard and thick, and the contents much shrivelled in dried stems, but by taking a very young frond a satisfactory section of the stalk can be made, and then about five isolated slender fibro-vascular bundles may be seen.

The fronds are usually much elongated, and are narrowly linear-lanceolate in outline. Usually the lower pinnæ or segments are gradually reduced in length until the lowest of them are merely slight dilations of the narrow wing of the stalk. The middle segments are much dilated at the base, and usually more so on the upper side than on the lower. In one of Dr. Garber's largest specimens there are seventy-five segments on each side, the largest of them three inches long, and having a breadth at the base of half an inch, which is immediately contracted to a quarter of an inch, and then gradually narrows to the end. The segments are usually entire, but are pinnately lobed in some Cuban fronds, and in one from Miss Reynolds. The color of the segments in the living plant and in well-preserved specimens is a good herbaceous green;

but most herbarium specimens, having been less carefully dried, turn to a dull olive-green, or even almost black.

The rigid midrib, the midveins and the bases of the veins are purplish-black, but the veinlets are of the same color as the parenchyma, and are therefore extremely difficult to see. The veins have, as in most Polypodia, a branch on the upper side, starting close to the midrib, and this veinlet is soriferous. The lower branch is again forked, or sometimes divided into three veinlets, which run nearly to the edge of the segment. In the form which Mr. John Smith referred to Goniophlebium these upper veinlets unite at their tips, and form a series of areoles enclosing the sori. This form I have from Panama; and, according to Fournier, something like this was the plant figured by Plumier, on which the Linnæan P. pectinatum was originally founded. mier neither figures the veins, nor says anything about them, and his whole figure and description so well accord with our plant that it seems best to follow the opinion of Swartz, Willdenow and Hooker, who all considered his plant to be the same as the P. pectinatum of their own writings.

Polypodium Plumula, a smaller plant than the present, long known as existing in Florida, will be figured in a later Part of this work, and the distinctions between that species and this one will then be pointed out.

Plate XLII. — Fig. 1, *Polypodium pectinatum*, from Manatee, Florida. Fig. 2 is an enlarged portion of a pinna. Fig. 3, a spore, highly magnified.

#### PLATE XLII. - Fig. 4-7.

## POLYPODIUM PHYLLITIDIS, LINNÆUS.

#### Hart's-tongue Polypody.

Polypodium Phyllitidis:—Root-stock stout, fleshy, creeping, sparingly chaffy with deciduous rounded or cordate scales; fronds almost sessile, one to three feet high, linear-lanceolate, acute at the apex, very gradually narrowed at the base, entire or slightly sinuate, firmly chartaceous or sub-coriaceous, yellowish-green, smooth and shining; veins diverging from the midrib at an angle of about sixty degrees, running nearly straight to the margin, mostly about two lines apart, more distant below, connected by from six to twelve series of angularly arched transverse veinlets, from the outer angles of which proceed usually two short simple or sometimes forked free soriferous veinlets, and often between them an additional veinlet connecting successive arcs; sori in a double row between the primary veins, commonly placed below the apex of the fruiting veinlet.

Polypodium Phyllitidis, Linnæus, Sp. Pl., p. 1543.—Swartz, Syn. Fil., p. 28.—Willdenow, Sp. Pl., v, p. 157.—Mettenius, Fil. Hort. Lips., p. 34; Polypodium, p. 83.—Eaton, in Chapman's Flora, p. 588.—Hooker, Sp. Fil., v, p. 38.—Hooker & Baker, Syn. Fil., p. 348.—Garber, in Bot. Gazette, iii, p. 83.

Polypodium repens, Mettenius, Fil. Hort. Lips., p. 34, t. xxiv, f. 1, 2.— Eaton, Fil. Wright. et Fendl., p. 199.

Campyloneuron Phyllitidis, Presl, Tent. Pte-id., p. 190.—Link, Fil. Hort. Berol., p. 124.—Fée, 11me Mém., p. 69.—Fournier, Pl. Mex., Crypt., p. 85.

Campyloneuron Moritzianum, Fée, Gen. Fil., p. 258.

Campyloneuron latum, Moore, Index Fil., p. 225.

Cyrtophlebium Phyllitidis, J. Smith, "in Jour. Bot., iv, p. 58

Cyrtophlebium nitidum, Brackenridge, Fil. of U. S. Expl. Exped., p. 39. Lingua Cervina longis angustis et undulatis foliis major, Plumier, Fil. Amer., p. 114, t. 130.

Lingua Cervina multifido cacumine laciniata, Plumier, l. c., p. 115, t. 131.<sup>1</sup>

HAB.—South Florida, many collectors; noticed near Indian River and at Biscayne Bay by Dr. PALMER, on stumps, etc., in cypress swamps on the Caloosa-hatchie, by Messrs. J. Donnell Smith and C. F. Austin, and in several places in Dade and Manatee Counties, by Dr. Garber, who says the root-stocks are commonly lodged in the decaying trunks of prostrate trees, or in old stumps near the ground, and sometimes on the ground where the soil consists chiefly of decomposing vegetable matter. The fern is found abundantly in the West Indies, in Mexico, Central America and in South America as far as Brazil.

DESCRIPTION: - The root-stock of this fern is, when fresh,

I Plumier's plate 134 represents a closely-allied plant with a long and comparatively slender rhizoma. On this was founded *P. repens* of Swartz, which Hooker and Baker have regarded as a distinct species, but which Fournier considers a variety of *P. Phyllitidis*. If Fendler's Venezuelan 229 and 230 are the true *P. repens* there can be no doubt that it is a good species.

nearly as thick as one's finger, several inches long, fleshy, covered with cinnamon-brown tomentose rootlets, and marked on the upper surface with a double row of crowded cup-like scars. The fronds to the number of six to twelve, according to Dr. Garber, but "often twenty or more," as observed by Messrs. Smith and Austin, stand very close together on the newer part of the root-stock. The stalk is very short, being never more than two or three inches long, and often much less. It is rather stout, and green in the living plant. At the very base, and on the root-stock, are a few fuscous scales, usually rounded and cordate, but sometimes pointed. These soon fall away, leaving the root-stock bare, until it is covered by the interlacing roots. The transverse section is rounded at the back and discloses three furrows on the front, the middle furrow broader than the others. The ridges which are outside of the lateral furrows become more and more prominent higher up the stalk, and so pass very gradually into the long decurrent margins of the frond. Within the stalk are two rather large fibro-vascular bundles just beneath the sides of the middle furrow, and back of them about seven much smaller bundles arranged in a semicircle.

The fronds sent by Dr. Garber vary from less than an inch long, in seedling plants, to others nearly three feet long and over two inches wide in the middle. These measurements are sometimes exceeded in exotic specimens: I have one frond from the province of Huasteca in Mexico, collected by Ervendberg, which is fully four and a quarter inches wide

in the widest place. The apex of the frond narrows gradually to a point, but is seldom fairly acuminate. From about the middle, or a short distance below the middle, the frond tapers gradually to the base, and passes into the stalk by such insensible degrees that it is impossible to say where the stalk ceases and the blade begins. The substance of the frond is thin, but rigid, having almost the consistence of parchment. It is smooth and glossy on both surfaces. The color of the living fronds is said by Dr. Garber to be yellowish-green, and he notices a translucency which is mostly lost in drying.

A monstrosity having fronds with laciniately multifid apices is occasionally seen in cultivation. Mr. Wright collected a few such specimens in Cuba, and Plumier's plate 131 represents the same thing.

The midrib is straight and strong, flat or slightly furrowed above, and very prominent beneath. Owing to the rigidity of the whole frond, and especially of the midrib, the fronds stand very erect and straight, and have nothing of the gracefully recurved appearance which is seen in Asplenium serratum (see page 18 of this work). The margins of the frond are lightly undulated, and the very edge is thickened, thereby increasing the rigidity of the frond.

The primary veins are exceedingly numerous and very conspicuous. They diverge obliquely from the midrib, and run nearly straight aimost to the edge of the frond. As in the other species of the section *Campyloneuron*, the primary veins are connected by arched veinlets, which emit from their

outer side several ray-like veinlets. In the present species the middle ray is generally continued to the next arch, and so the primary areoles are divided by a veinlet parallel to the main veins and between them, but more or less interrupted in its course, and never extending down to the midrib. The other rays are shorter, and either simple or forked, the ends being free and slightly enlarged; this enlarged end is often marked on the upper surface of the frond by a minute dot, either blackish or white and chalk-like. Below the end these rays bear rather large rounded fruit-dots, generally two in each primary areole. Rarely, the radial veinlets are so irregular that the space between the arches is cut up into numerous undefinable polygons. Something of this may be seen in plate XXIV of the work on the Ferns of the Leipzic Garden by Dr. Mettenius.

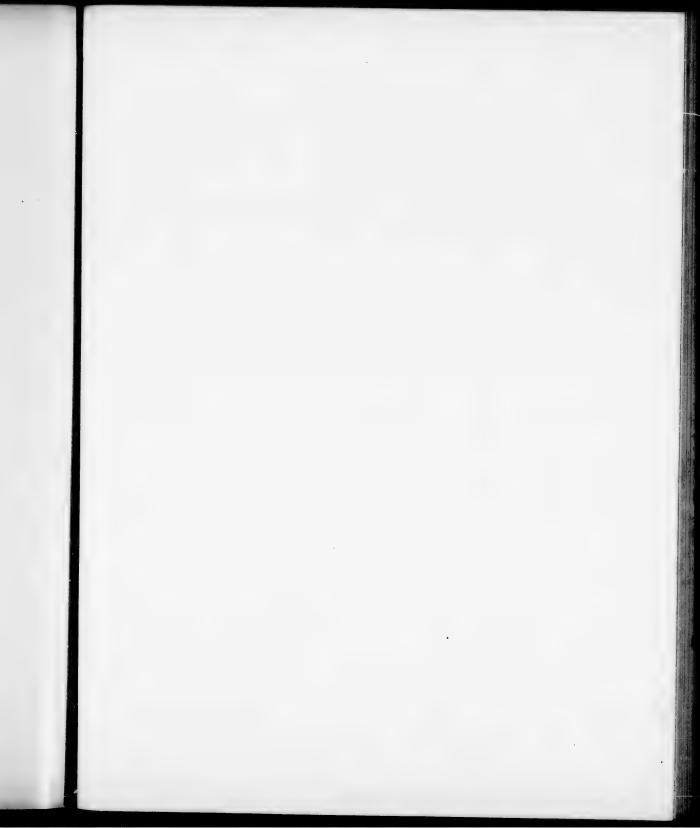
The spores of this fern are oblong-ovoid, or slightly reniform, and marked with a single vitta.

The species of the section Campyloneuron are few in number. Those admitted by Hooker and Baker are P. angustifolium, P. lucidum, P. sphenodes, P. coarctatum, P. lævigatum, P. repens, P. Phyllitidis, P. decurrens and P. Fendleri. The last two have pinnate fronds: all the others have more or less elongated simple fronds. All are American, none of the section having ever been discovered in any part of the Old World. In the narrowest forms the peculiar venation is not so clearly evident as in the broader ones, and shows something of a transition to that of Goniophlebium. But on the

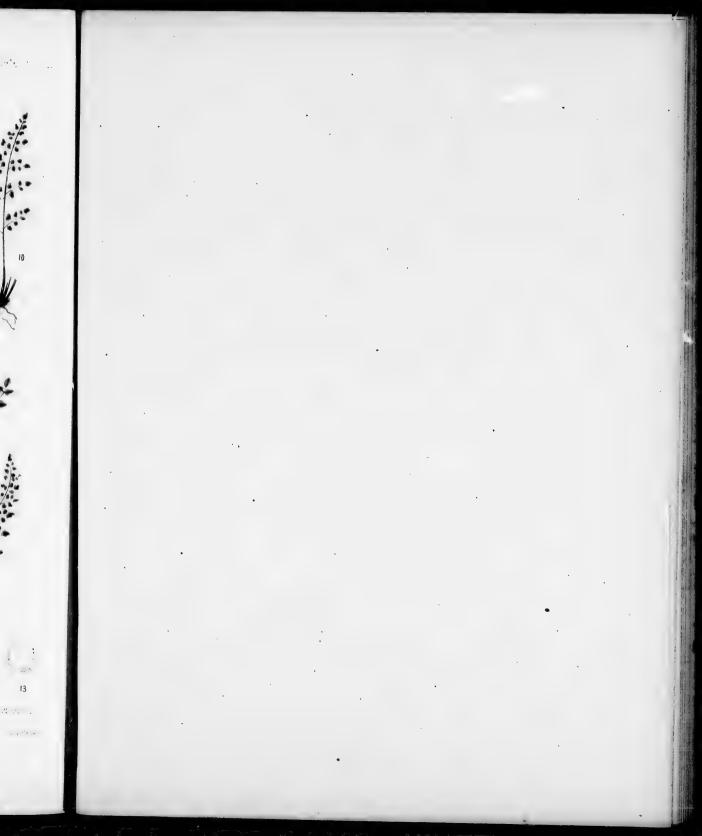
whole the group is very natural, and is maintained as a genus by Fournier, although he rejects Goniophlebium and Lepicystis.

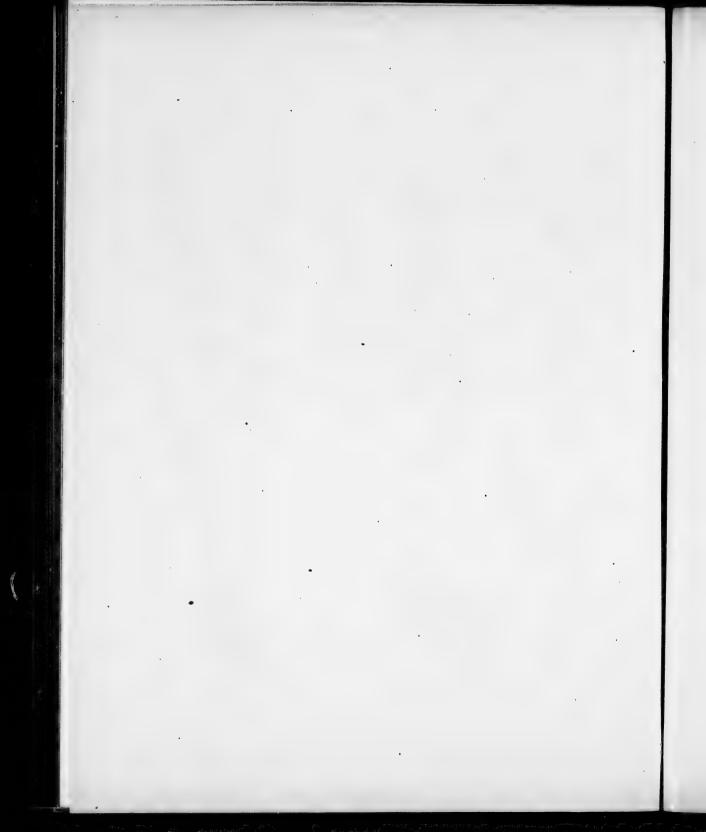
Phyllitis is an ancient name of the Hart's-tongue, and the specific name given to the present fern by Linnæus refers to the similar shape of the fronds of the two species.

Plate XLII.—Fig. 4-7. Polypodium Phyllitidis. Fig. 4 is a frond of the natural size, collected by Dr. Garber. Fig. 5 is a seedling plant. Fig. 6 is a portion of a frond somewhat enlarged, and showing the venation. Fig. 7 is a spore, highly magnified.









# PLATE XLIII. - FIG. 1-4.

# PELLÆA BRIDGESII, HOOKER.

## Bridges's Cliff-Brake.

Pellæa Bridgesii:—Root-stock short, creeping, densely chaffy with narrow scales; stalks three to six inches long, clustered, terete, wiry, dark-reddish-brown, smooth and shining; fronds as long as the stalks, linear-oblong, simply pinnate; pinnæ five to eighteen pairs, mostly opposite, nearly sessile, glaucous-green, coriaceous; sterile ones orbicular or sub-cordate, four to five lines long, rarely larger; fertile ones a little narrower, commonly at first conduplicate and so seemingly lunate; involucre narrow, formed of the whitish cartilaginous margin of the pinnæ, soon flattened out and exposing a very broad intramarginal band of sporangia.

Pellaa Bridgesii, Hooker, Sp. Fil., ii, p. 238, iii, t. cxlii, B.—Hooker & Baker, Syn. Fil., p. 151.—Eaton, Ferns of the South-West, p. 323.

Hab.—Clefts of rocks in the Sierra of California, usually above the elevation of 6,000 feet. Discovered by Thomas Bridges, and since collected by Professor Brewer at Ebbett's Pass (8,000 to 9,000 feet elevation), in Silver Valley and in the Yosemite Valley; by William Lobb, the station not recorded; by Mr. Bolander near the Mariposa Sequoia Grove; by Dr. Torrev among mountains near the Yosemite Valley, etc., etc.

DESCRIPTION: - This fern grows in tufts formed of many creeping and entangled root-stocks, which are very heavily clothed with very narrow linear-acuminate scales. scales have a ferruginous color, mostly due to a strong midnerve which is found in nearly all of them. The stalks are densely clustered on the root-stocks, and are mostly about five inches long, round, rigid, dark-reddish-brown in color, having a moderate degree of lustre, and are devoid of chaff except at th base. The greater part of the stalks remain attached to the root-stock long after the fronds have disappeared. A section of the stem shows on the exterior a single layer of minute firm-walled cells, and in the middle of the parenchyma a well defined circle of sclerenchyma, within which is a single horse-shoe-shaped fibro-vascular bundle. The frond is from three to six inches long, and rarely over three-fourths of an inch wide. It consists of a terminal pinna and from five to eighteen pairs of lateral pinnæ, the upper ones and the lowest but very little smaller than the rest, all attached by very short plum-colored or reddish-brown petioles to a rachis which is like the stalk in all its characters.

The pinnæ are almost coriaceous in texture, perfectly smooth, and of a pale glaucous-green, certainly in dried plants. The sterile pinnæ are orbicular with a slightly heart-shaped base, which often somewhat encloses the rachis: they are usually about four lines in diameter and length, but occasionally are found fully twice this size. The fertile pinnæ are as long as the others, but commonly a little narrower, so as to

be cordate-ovate in shape. They are almost always folded longitudinally, so that the two sides have their under surfaces closely applied together, and they are then slightly curved upwards along the midvein, giving them something of a crescent-like shape. The veins, of which there are from eight to twelve pairs in a pinna, diverge angularly from the midvein, and curve outwardly. They are dichotomously forked three or four times, so that the veinlets near the margin are very close together—not the hundredth part of an inch apart. Here and there the veinlets are seen to anastomose angularly, especially near the midvein, less regularly so, however, than in the two species composing Mr. Baker's section Holcochlana.

The sporangia form linear sori on the upper part of the veinlets, often descending as far as the last forking of the veinlets. As the veinlets are so very close together, the sori collectively form a broad intramarginal band of fructification. The margin of the pinnæ is thin, wrinkled, white and cartilaginous, and is at first so reflexed as partly to cover the sporangia, but it is soon flattened out. The spores are nearly globular, roughened, and faintly trivittate.

A thing which has escaped notice hitherto is the presence on the back of the frond, especially between the lines of sporangia, of a little of the same yellowish ceraceous powder which is characteristic of the section Cincinalis of Notholana, and of certain species of Cheilanthes and Gymnogramme. Indeed the very scantily reflexed involucre would seem to indicate that the plant would be quite as well placed in Notholana

as in *Pellæa*, a genus in which, I believe, no other species with farinaceous fronds have as yet been placed. But the fern most nearly resembling this one is *Pellæa rotundifolia*, of New Zealand, a plant with taller fronds, equally rounded pinnæ, and a shaggy-paleaceous stalk and rachis. I am content, therefore, to leave this fern in *Pellæa*, section *Platyloma*, where it is placed in Synopsis Filicum.

Plate XLIII.—Fig. 1-4. Pellaa Bridgesii, a specimen from the Mariposa Grove collected by Mr. Bolander. Fig. 2 is an enlarged pinna. Fig. 3 is a portion of a pinna more highly magnified, and showing the margin partly reflexed. Fig. 4, a spore.

### PLATE XLIII. - Fig. 5-8.

# PELLÆA BREWERI, D. C. EATON.

#### Brewer's Cliff-Brake.

Pellæa Breweri:—Root-stock ascending, short, stout, very chaffy with narrow linear-acuminate fulvous scales; stalks crowded, two to four inches long, terete, very fragile, bright-brown, chaffy only at the base; fronds as long as the stalks, oblong, pinnate; pinnæ six to twelve pairs, short-petioled, membranaceous, half to three-fourths of an inch long, mostly two parted, the upper lobe largest; lobes and simple upper pinnæ ovate or triangular-ovate, cuneate and often sub-cordate at the base; veins free, curving outwards, twice or thrice forked; sporangia at the ends of the veins, covered by a delicate continuous involucre.

Pellaa Breweri, Eaton, in Proceed. Amer. Acad., vi, p. 555; Botany of U. S. Geol. Expl. of 40th Parallel, p. 395, t. xl, fig. 17.— Hooker & Baker, Syn. Fil., p. 145.

HAB.—Common in the clefts of exposed rocks in the higher canons of the Sierra of California, and thence eastward to the East Humboldt Mountains and the Wahsatch; also found near Loma in Colorado, near the Rio Grande. First collected in 1863 by Professor W. H. Brewer near Sonora Pass, at 7,000 to 8,000 feet elevation, and afterwards in Ebbett's Pass at the same altitude. Mono Pass, at 9,000 to 10,000 feet elevation, BOLANDER. East Humboldt Mountains, WATSON. Wahsatch Range, WATSON, EATON. Loma, LOEW.

DESCRIPTION: - In its habit of growth this little fern is very much like the last; it is about the same size, it grows in similar places, and the root-stocks are similarly condensed and very chaffy, but the scales are longer and have a brighter color; they are more crisped and much softer, and have no vestige of a midnerve. The stalks are very numerous and densely crowded; they are terete, wiry, bright-brown and lustrous, but they are marked, in herbarium specimens at least, with many little transverse depressions, or incipient cracks, so that they are extremely fragile. They commonly break off about an inch from the root-stock, leaving their lower portion for a long time adherent to the latter. They are chaffy only at the very base, the scales being similar to those of the rootstock. The transverse section shows a single central fibrovascular bundle something the shape of the expanded wings of a butterfly, surrounded by a very thin layer of sclerenchyma.

The frond is usually about four inches long, and a little more than an inch wide, but some specimens have fronds a little smaller than this, and now and then one is seen considerably larger. The frond consists of a rachis like the stalk in color and fragility, and of several pairs of pinnæ, commonly about nine pairs, besides the terminal pinna. The terminal pinna and a few of those nearest it are triangular-ovate, entire and almost sessile by a contracted base: the lower pairs are

more and more distinctly two-lobed, the upper lobe very much larger than the lower one in the middle pinnæ and considerably larger in the lower pinnæ. In a few little fronds from Loma the lower two or three pairs of pinnæ have three or four lobes, the middle or terminal lobe the largest. When three-lobed, the pinnæ are hastate; when four-lobed there are two lateral lobes on the inferior side and one on the superior. The pinnæ are bright-green in color, and thinly membranaceous in texture, much thinner than in Pellæa Bridgesii, P. andromedæfolia and P. flexuosa, though not so delicate as in P. gracilis.

The veins are pinnately arranged along the sides of a rather delicate and slightly flexuous midvein; they fork twice or three times, and the veinlets curve gradually more and more away from the midvein, until they terminate just at the edge of the pinna in the sterile fronds, or just at the beginning of the delicate, whitish and conspicuous involucre in the fertile ones.

The sporangia grow on the veins, just at their tips; at first they are covered by the involucre, but when fully ripe they often extend a very little beyond its reach. The spores are nearly globose, and have three faint radiating vittæ.

Among American ferns this species comes nearer to Pellaa gracilis than to any other, but has a stout root-stock, a far heavier stalk and rachis, differently shaped and differently compounded fronds, and veins placed very much closer together. Pellaa auriculata, from Cape Colony, is perhaps a

nearer ally, but in that species, too, the pinnæ are usually symmetrically lobed and the veins less crowded.

Cheiloplecton was a genus proposed by Fée ( Mém., p. 33) for the Mexican Pteris rigida of Swartz. It differed "from Pteris in the absence of a receptacle, from the Pelleas in having convoluted and veiny margins, and from Cheilanthes in appearance, consistence, and the shortness of the sori, which are hidden under the infolded margins." This name Cheiloplecton was taken, by the authors of Synopsis Filicum, for the name of a section of Pellaa, characterized by an herbaceous or subcoriaceous texture, clearly visible veins, and a broad involucre, which in most of the species is rolled over the sorus till full maturity. To this section are referred Pellea auriculata, Breweri, Seemanni, gracilis, pilosa, coluaniæfolia, Tamburii, deltoidea, Skinneri, rigida. B. the added species show so strongly a revolute or so plainly a striated involucre as are seen in Fée's original species, and several of them differ very much in habit from the others; it seems, therefore, most probable that in the next general revision of the genus some new arrangement of the sections will be necessary.

Plate XLIII.—Fig. 5-8.—*Pellaa Breweri*, from Mono Pass. Fig. 6 is a lower pinna, enlarged. Fig. 7, a small part of the same more highly magnified. Fig. 8, a spore.

#### PLATE XLIII. - Fig. 9-13.

#### NOTHOLÆNA TENERA, GILLIES.

#### Tender Notholæna.

Notholæna tenera:—Root-stock short, "erect," chaffy with narrow linear-acuminate ferruginous scales; stalks tufted, wiry, brownish, smooth and shining; fronds (in our plant) one to four inches long, oblong or the larger ones ovate-pyramidal, once to thrice pinnate; pinnæ mostly opposite, rather distant, the lowest pair usually largest and most compound; ultimate pinnules one or two lines long, ovate, often sub-cordate, obtuse, smooth and naked on both surfaces, tender and herbaceous, but slightly fleshy; sporangia borne on the upper part of the forked veins, sometimes covering the greater portion of the surface of the pinnule.

Notholæna tenera, Gillies, in "Bot. Mag., t. 3055."— Kunze, Die Farrnkräuter, i, p. 44, t. xxii, 2.— Hooker, Gen. Fil., t. lxxvi, A; Sp. Fil., v, p. 122.— Brackenridge, Fil. of U. S. Expl. Exped., p. 20.— Mettenius, Fil. Hort. Lips., p. 46.— Hooker & Baker, Syn. Fil., p. 373.— Eaton, Ferns of the South-West, p. 309.

Cincinalis tenera, Fée, Gen. Fil., p. 160.—J. Smith, Ferns, Brit. and Foreign, p. 178.

Gymnogramme tenera, METTENIUS, Cheilanthes, p. 7.

Hab.—Crevices of perpendicular rocks in Southern Utah, Dr. Parry, May, 1874, Dr. Palmer, 1877. Chili, Bolivia and Peru.

Description:—The root-stocks are very short, ascending or erect, and chaffy with very narrow slender-pointed ferruginous scales destitute of midnerve. The stalks are sometimes several inches long, especially in the specimens collected near Obrajillo in Peru by the botanists of the U. S. Exploring Expedition, but in the specimens from Utah they are not more than two inches long, sometimes much less. They are wiry, dark-brown or almost black, smooth and shining, though without the high polish of the stalks of most Adianta. The stalks and the similar rachis, with at least the lowest portion of its branchlets, persist long after the pinnæ have fallen off, so that the fronds are surrounded by a bristling mass of old stalks. The section of the stalk shows a solitary central somewhat triangular fibro-vascular bundle.

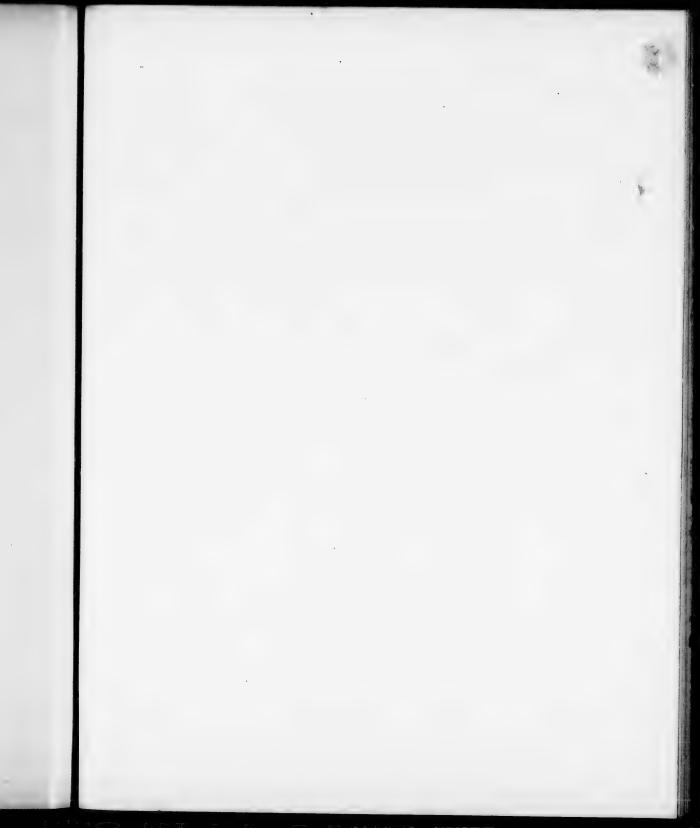
The fronds, in our plant, are from one to three inches long. The fronds of the smallest plants are simply pinnate, with a few pairs of roundish or slightly cordate sterile pinnæ about two lines long and broad. The fronds of larger plants are narrowly triangular-ovate in outline, and are twice pinnate, all but the uppermost pinnæ having a distinct petiole of the same rigid character and dark color as the rachis. The pinnæ are mostly divided into about five ovate or subcordate pinnules from one to two lines long. In the lowest pinnæ these pinnules show a tendency to become again divided. The texture of the pinnules is tender, but at the same time rather fleshy, or sub-coriaceous. They have both surfaces perfectly smooth, and the color is a full herbaceous green, in-

clining to glaucous, according to Kunze and Hooker. The veins are rather few, and are once, or the lower ones twice, forked, the veinlets curving outward to the margins of the pinnules. The sporangia are seated on the upper part of the veinlets, but often descend so far towards the midvein as to give the plant fully as much the character of *Gymnogramme* as of *Notholæna*. The green margin of the pinnules extends a little beyond the end of the veinlets, and is a little thinner than the middle part of the pinnules; it shows a faint tendency to be reflexed over the outermost sporangia, but is by no means a true involucre. The spores are globose and faintly trivittate.

There is a little doubt as to whether the specimens sent from Utah by Drs. Parry and Palmer can be fairly referred to the South American N. tenera. I learn from Professor Gray that Mr. Baker, who has access to the original specimens collected in Chili by Dr. Gillies, thinks that they cannot, and it is with no little hesitation that I venture to adhere to the contrary opinion. I have not seen the figures in the Botanical Magazine, and the specimens I have from Chili and Peru are scanty. But they are taller and larger than the Utah plant, more compound, and have the "elliptical" pinnules described by Hooker, and figured in his Genera Filicum. On the other hand our plant corresponds very well to Kunze's figures, especially to that marked a in his plate, where we see one of the fronds simply pinnate with cordate-ovate very slightly hastate pinnules, almost exactly like some

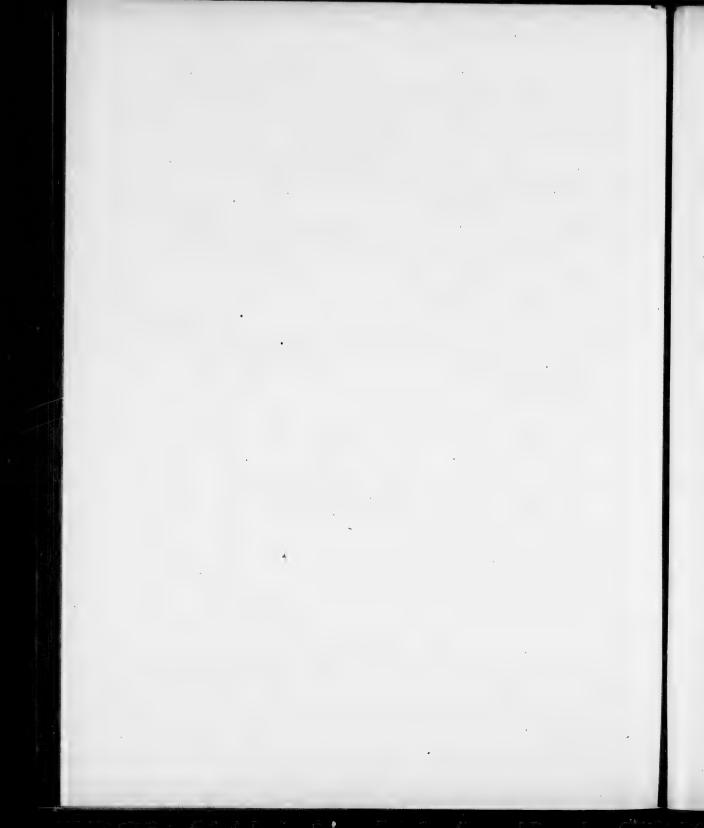
of the Utah specimens. The subcoriaceous, yet herbaceous and tender texture of the pinnæ is not less characteristic of our plant than of the Chilian, and the sori, sometimes submarginal, sometimes descending far towards the midvein, are the same in both. In fact, the difference is just about the same as that existing between the *Pellæa pulchella* of New Mexico and the same species as collected in Chiapas. *Notholæna tenera* is confessedly very near to *N. nivea*, from which it differs mainly by the absence of ceraceous powder from the under surface of the frond; but Hooker found traces of the powder in specimens from Bolivia, and has expressed a doubt as to the distinctness of the two species.

Plate XLIII.—Fig. 9-13. Notholona tenera. The plants represented are all from Southern Utah, collected by Drs. Parry and Palmer. Fig. 12 is an enlarged pinnule. Fig. 13, a spore.









#### PLATE XLIV.

# DICKSONIA PILOSIUSCULA, WILLDENOW.

# Hay-scented Fern; Hairy Dicksonia.

DICKSONIA PILOSIUSCULA: Root-stock very slender, creeping, much elongated; stalks scattered, erect, sometimes a foot long, greenish in the living plant, fading to brownish-straw-color, slightly puberulent; fronds one to three feet long, ovate-lanceolate in outline, long-pointed, delicately herbaceous, hairy and minutely glandular, pinnate or almost bipinnate; pinnæ numerous, lanceolate, pointed, the second pair a little longer than the first; pinnules adnate to the secondary midrib, and usually decurrent on it, rhomboid-ovate, pinnatifid into oblong and obtuse cut-toothed lobes; sori minute, in cup-like involucres which are seated on minute recurved teeth, usually one at the upper margin of each lobe of the pinnules.

Dicksonia pilosiuscula, WILLDENOW, "Enum. Pl. Hort. Berol., p. 1076; Sp. Fil., v, 484.—Pursh, Fl. Am. Sept., ii, p. 671.—Hooker, Fl. Bor.—Am., ii, p. 264.—Torrey, Fl. New York, ii, p. 502.—Bigelow, Fl. Boston., ed. iii, p. 424.—Wood, Botanist and Florist, p. 376.

Polypodium pilosiusculum, Muhlenberg "in litt."

Sitolobium (or Sitobolium) pilosiusculum, Desvaux, "Prodr., p. 262."

Adectum pilosiusculum, Link, Fil. Hort. Berol., p. 42.

Dicksonia pubescens, Swartz, in Schkuhr, Krypt. Gew., p. 125, t. 131.— Presl, Tent. Pterid., p. 136.

Dicksonia punctiloba, Hooker, Sp. Fil., i, p. 79.—Hooker & Baker, Syn. Fil., p. 55.—Fée, Gen. Fil., p. 355.

Aspidium punctilobum, Willdenow, Sp. Pl., v, p. 279.—Pursh, Fl. Am. Sept., ii, p. 664.

Sitolobium punctilobum, J. SMITH.

Dicksonia punctilobula, Gray, Manual, ed. i, p. 629, etc.—Kunze, in Sill. Journ., July, 1848, p. 87; in Linnæa, xxiii, p. 249.— Darlington, Fl. Cestr., ed. iii, p. 394.—Mettenius, Fil. Hort. Lips., p. 105.—Eaton, in Chapman's Flora, p. 597.—Williamson, Ferns of Kentucky, p. 119, t. xlvi.

Nephrodium punctilobulum, MICHAUX, Fl. Bor.-Am., ii, p. 268.

Aspidium punctilobulum, SWARTZ, Syn. Fil., p. 60.

Dennstædtia punctilobula, Moore, Index Fil., p. xcvii, 307.—Lawson, in Canad. Nat., i, p. 287.

HAB.—Moist woods, and often in low grassy places; a common fern in New Brunswick, Canada, New England and the Middle States extending westward to Indiana, and possibly farther, and southward as far as Central Alabama, where it was found on the cliffs of the Cohaba River by Professor Eugene A. Smith. It is not mentioned in the catalogues of plants of Wisconsin, nor does Professor Harvey report it as found in Arkansas. It is probably confined to Eastern North America, although Kunze claimed to have specimens from the West Indies.

DESCRIPTION: — The root-stock creeps extensively an inch or two below the surface of the ground. It is about a line and a half or two lines thick, perfectly round, and nearly naked, bearing instead of chaff a very scanty covering of

slender jointed hairs at its growing extremity. It is irregularly branched, often forked, and emits long and slender rootlets along its whole extent. The section shows a broad exterior ring of light brown parenchyma; inside of this is a broad circle of minute white starch-cells, then the scalariform vessels in a narrow ring, bordered by other minute cells, which are most probably bast-cells; inside of this is another broad circle of the starch-cells, and in the very centre is a roundish mass of brown sclerenchyma. The whole section has such a regular concentric system that it is not only very pretty to look at, but would be very well suited for anatomical study in the class-room.

The stalks are seldom more than two or three to a root-stock, and rise from it several inches back of its apex. In advance of them may be seen the rudiments of next year's stalks. The stalks are roundish on the back and furrowed on the front. They are not articulated to the root-stock, but are continuous with it. Very often the stalk is found to have a short branch just above its base. This branch has the structure of the root-stock, and undoubtedly may grow into a full-sized rhizoma. The section of the stalk shows a thin outer sclerenchymatous sheath, and, within the colored parenchyma, a broad and thin vascular band, its edges turned up almost at right angles with the middle part. This structure may be seen, though somewhat modified, even below the little branch just described, proving, what is perhaps hitherto unknown in ferns, that a stalk may branch out into a root-stock.

The fronds are singularly feathery and graceful in their appearance. They are rarely less than a foot long, and may attain a length of over three feet. They are green, delicately herbaceous, withering very quickly when plucked, but often bleaching very prettily in the autumn. The upper surface is nearly smooth, but the under-surface is minutely glandular-puberulent, and sometimes finely hairy. In drying they give out a rather pleasant hay-like odor, though by no means so fragrant as two or three of the wood-ferns. They are ovate-lanceolate in outline, tapering very gradually from just above the rather broad base to a long and slender apex.

The pinnæ repeat in miniature the outline of the frond. In all but the lower pinnæ of the very largest fronds the secondary rachises are narrowly wing-margined by the decurrent bases of the adnate segments or pinnules. These segments are oblong-ovate, mostly obtuse, pinnatifid often rather more than half way to the midvein into oblong toothed lobes. The largest pinnæ are from three to six inches long; the pinnules from half an inch to an inch long; the lobes from one to three lines long, and the teeth about the fourth part of a line. The veins and veinlets are all free; the latter so branched that a veinlet runs to every one of the minute lobules or teeth.

A fertile frond, as is very common in ferns, is fertile only in its upper half, the lower pinnæ being usually sterile. The fruit-dots are very minute, and are placed on the lowest tooth on the upper side of the lobes of the segments. Com-

monly there is but one fruit-dot to a lobe, but sometimes there are two on the upper side, and rarely a third on the lower. The involucre is like a little cup, and is formed partly from the reflexed tip of the fertile tooth or lobule, and partly of a special true involucre, which meets the other part and is united with it. Inside the cup are found about a dozen sporangia, which have from twenty to twenty-four articulations in the ring. The spores are trigonous with somewhat impressed sides, and three faint vittæ along the angles.

There has been a great deal of confusion respecting the names of this fern, both generic and specific. Dicksonia was proposed by L'Heritier in 1788 for two species, D. Culcita of the Azores and Madeira, and D. arborescens of St. Helena. In these the involucre is very distinctly twovalved, the outer valve formed from the apex of a lobe. About a dozen other species are now known, which are plainly congeners of these two. In 1801, Bernhardi proposed a genus Dennstædtia for the Trichomanes flaccidum of Forster, a fern much more like our own, and, like it, having a cup-like, and not two-valved, involucre. But the proposed genus was promptly rejected by Swartz, Schkuhr and Willdenow, and the plant referred to Dicksonia, which by 1810 was made the recipient of as many as twenty species. Since then Sitobolium (or Sitolobium), Patania and Adectum have been proposed for some of these species with cup-like involucres. Some of these names have met with a limited acceptance, but all were rejected by Hooker. The authors of Species

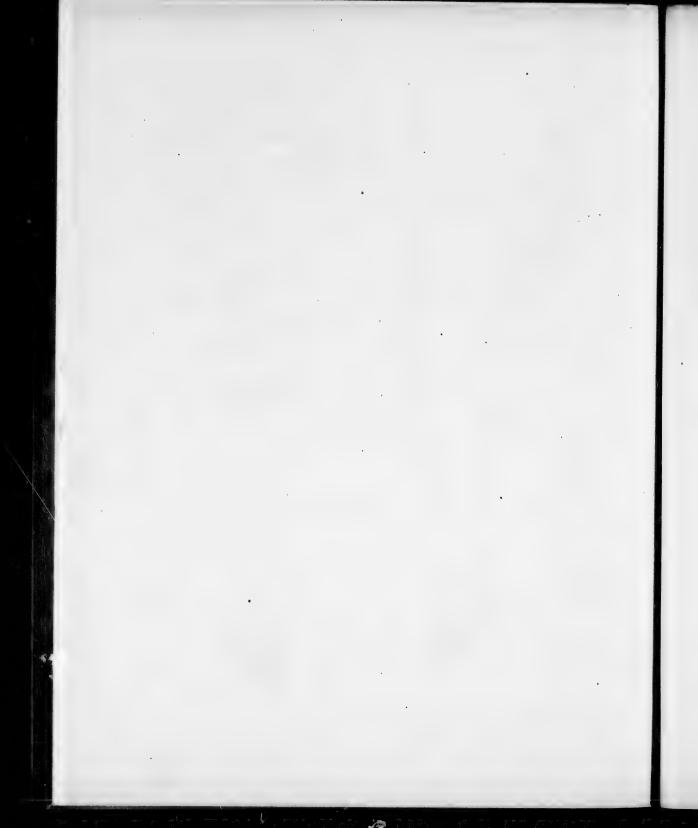
Filicum have also added the species of Cibotium to Dicksonia, but these have the outer half of the involucre separate from the lobule; and this character, with their peculiar habit, is, perhaps, enough to justify their being kept distinct. oldest name for our plant is Nephrodium punctilobulum, of Michaux, published in 1803. In 1806, Swartz called it Aspidium punctilobulum. In 1809, Willdenow named it Dicksonia pilosiuscula, and in the same year, as nearly as I can discover, Schkuhr figured and described it as D. pubescens, although attributing the name to Swartz. It was not till about 1843 that Hooker published the name of D. punctiloba, taking the orthography from Willdenow's Aspidium punctilobum. In the Spring of 1848, Gray's Manual first gave the name D. punctilobula, and Kunze followed in July of the same year with the same name. But if a species is to have the name under which it was first referred to its proper genus, then either Willdenow's or Swartz's name is to be chosen.

The specimen figured was collected on the Peaks of Otter, in Virginia, by Mr. A. H. Curtiss. The cup-like involucre and the other magnified details are well represented by Mr. Faxon.









### PLATE XLV.—Fig. 1-5.

# CHEILANTHES TOMENTOSA, LINK.

#### Webby Lip-Fern.

CHEILANTHES TOMENTOSA:—Root-stock short, chaffy with glossy subulate scales; stalks tufted, four to eight inches long, erect, rather stout, clothed with soft woolly pale-ferruginous hairs, intermixed with others which are flattened and decidedly paleaceous; fronds eight to fifteen inches long, oblong-lanceolate, webby-tomentose with slender brownish-white obscurely articulated hairs, especially beneath, tripinnate; primary and secondary pinnæ oblong or ovate-oblong; ultimate pinnules closely placed, but distinct, roundish-obovate, sessile, or adnate to the tertiary rachis, one-half to three-fourths of a line long, the terminal ones twice longer; involucres whitish, continuous round the pinnule and very narrow.

Cheilanthes iomentosa, Link, "Hort. Berol., ii., p. 42."—Fil. Hort. Berol., p. 65.—Kunze, in Sill. Journ., July, 1848, p. 87; in Linnæa, xxiii., p. 245.—Gray, Manual, ed. ii., p. 592.—Mettenius, Fil. Hort. Lips., p. 50; Cheilanthes, p. 37.—Eaton, in Chapman's Flora, p. 590; Ferns of the South-West, p. 314.—Baker, Syn. Fil., p. 140.—Williamson, Ferns of Kentucky, p. 49, t. xi.

Myriopteris tomentosa, Fée, Gen. Fil., p. 149, t. xii., A., f. 2 (a pinnule).—Fournier, Pl. Mex., Crypt., p. 125 (species exclusa). Notholana tomentosa, J. Smith.

Cheilanthes Bradburii, HOOKER, Sp. Fil., ii., p. 97, t. cix., B.—METTENIUS, Cheilanthes, p. 37.

HAB.—Sandstone rocks along the French Broad River, in North Carolina and Eastern Tennessee, Professor Gray, Mr. Canby, Rev. D. R. Shoop, Professor Bradley, etc. Texas, Lindheimer, No. 743. Mountains of Virginia (?) and Kentucky, according to Gray's Manual, but Mr. Williamson has hitherto failed to find it in the last named State. The Kew herbarium contains, besides Lindheimer's plant, a very imperfect specimen marked "Manitou Rocks, 250 miles up the Missouri, Bradbury," and good specimens from Texas collected by Drummond. Kunze states that it was raised [at the Leipzig garden?] from Mexican spores, and that Rugel collected a few specimens in North Carolina; but Fournier rejects it as a Mexican species.

Description:—This is decidedly the largest plant among all our North American species of Cheilanthes, some of the tallest specimens measuring nearly two feet in total length. The root-stock is short, and disposed to branch. It is thickly clad with fine subulate chaff, many of the scales with a dark and rigid midnerve, and others lighter-colored and without midnerve. The plant evidently grows in dense masses. The stalks are clustered, each root-stock sending up a large number of them. They are rigid, wiry, terete and covered with grayish-tawny spreading soft woolly hairs, intermixed with a few which are broader and decidedly paleaceous, especially

towards the base. The section is round, and shows a firm exterior sclerenchymatous sheath, within which is a broad circle of brownish parenchyma, and in the middle a single fibro-vascular bundle obtusely triangular in shape, but with the sides slightly hollowed in.

The fronds vary from a few inches to over a foot in length; their general shape is ovate-lanceolate, or oblong-lanceolate; they are in general of a grayish color from the abundance of a fine entangled tomentum, which covers both surfaces, though it is a little thinner and whiter on the upper surface. The large fronds are fully tripinnate. The primary pinnæ are oblong-ovate, short-stalked, one to nearly two inches long, and a half to three-fourths of an inch broad at the base. They are either opposite or alternate, the lower ones, as usual, more separated than those that are higher up on the frond. The secondary pinnæ are close-placed, oblong, obtuse, and again pinnated into from two to five minute rounded or rounded-obovate sessile or adnate-decurrent pinnules on each side, besides a terminal oval pinnule which is twice as large as the lateral ones. These ultimate pinnules are innumerable, and it is in allusion to their very great number in this and the allied species that the generic name Myriopteris was proposed by Fée for the group.

The whole margin of the pinnule is recurved, and from the edge of it is produced a very delicate whitish involucre, the whole forming a sort of pouch, as is admirably represented in the figure given by Fée. The sporangia have a ring of about twenty articulations: Fée says there are vittate or knotted hairs growing among them. The spores are rather large, amber-colored, globose, and delicately trivittate. According to Fée, when placed in water they burst and dissolve into excessively minute sporules.

There can be no doubt that our plant is the Cheilanthes tomentosa of Link. Kunze, who knew Link's plant perfectly well, referred the North Carolina specimens to it; and Dr. Mettenius, who succeeded to the care of the Leipzig garden, favored me with specimens which are precisely the same thing as the plant here described. But none of the Mexican collectors seem to have found the species, and it may be legitimately queried whether the commonly reported origin of Link's specimens is the true one. The Cheilanthes tomentosa of the Species Filicum is partly this plant, but mainly the species next to be described.

Plate XLV.—Fig. 1-5. Cheilanthes tomentosa. Fig. 1 represents one of Professor Bradley's specimens. Fig. 2 is an enlarged pinnule. Fig. 3, an enlarged portion of a pinnule. Fig. 4, some of the woolly hairs magnified, and Fig. 5, a spore.

#### PLATE XLV.-Fig. 6-12.

## CHEILANTHES EATONI, BAKER.

#### Eaton's Lip-Fern.

Cheilanthes Eatoni: Root-stock short, chaffy with rather long slenderly acuminate glossy scales; stalks clustered, four to eight inches long, erect, wiry, covered, as are the rachis and its divisions, with narrow shining pale-ferruginous scales and paleaceous hairs intermixed; fronds four to nine inches long, oblong-lanceolate, pubescent above with whitish entangled woolly hairs, beneath covered with a heavy matted ferruginous tomentum, and more or less scaly, especially when young, tripinnate; pinnæ ovate-oblong, lower ones rather distant, upper ones crowded; ultimate pinnules contiguous, half a line long, rounded, but narrowed at the base, the terminal ones often twice larger and more decidedly obovate; margin of the pinnules continuously recurved, the edge slightly membranaceous.

Cheilanthes Eatoni, Baker, Syn. Fil., p. 140.—PORTER & COULTER, Synopsis of the Flora of Colorado, p. 153.—EATON, Ferns of the South-West, p. 315.

Cheilanthes tomentosa, Hooker, Sp. Fil., ii., p. 96 (description and Texas plant), t. cix., A.—EATON, in Botany of the U. S. and Mexican Boundary Survey, p. 234.

HAB.—Texas and New Mexico, Wright, No. 816; Fendler, No. 1016; Indian Territory, between Fort Cobb and Fort Arbuckle, Palmer; near Cañon City, Colorado, Brandegee; from the Rio Grande westward along the Gila to the Colorado River, Collectors of Mexican Boundary Survey. The kind of place where this fern has been collected is not recorded, but it probably grows in the clefts of rocks along the sides and edges of cañons.

DESCRIPTION: - This fern bears so close a resemblance to Cheilanthes tomentosa, that it is not at all surprising that there has been more or less of confusion between the two. It would seem that when writing his account of the genus Cheilanthes for the Species Filicum, Sir W. J. Hooker had, in his collection, no examples of the North Carolina C. tomentosa, and could identify it only by Link's rather imperfect description and Kunze's remarks in Silliman's Journal. Having Wright's specimens of the plant here described, and Gordon's fern from the Rattene Mountains - a plant not yet satisfactorily identified—he referred them to the species named by Link; and then perceiving with his accustomed delicate discrimination that Lindheimer's and Bradbury's plant was distinct from Wright's, he gave the former the name of C. Bradburii. It was not until 1860, when the Ferns for Chapman's Flora were being prepared, that any one suspected that the C. Bradburii was the true C. tomentosa. In 1866, I had

an opportunity of explaining the matter to Mr. Baker, then at work on the Synopsis Filicum, and not long after, I was surprised, and I need not say pleased, by finding that he had given to Hooker's *C. tomentosa* the name it now bears.

The root-stock is short, assurgent, and chaffy with rather rigid slender-pointed scales, most of them furnished with a dark midnerve. The stalks are tufted, and are perhaps a little slenderer than those of *C. tomentosa*. They are chaffy throughout, but more especially at the base, with narrow pale-ferruginous scales, intermixed with still slenderer paleaceous hairs. The section is slightly flattened on the anterior side. The exterior sheath is firm; inside of it is brownish parenchyma, and in the middle a semicircular fibro-vascular bundle, the ducts in the centre of it arranged in a figure much like a letter X.

They are similarly oblong-lanceolate and tripinnate, the ultimate pinnules being very numerous and rather more closely crowded than in the other species just referred to. The pubescence is harsher and not so webby on the upper side, and is decidedly heavier and more matted on the under surface. The scales of the branches, or secondary rachises, are broader and shorter than those of the stalk and are very conspicuous in young fronds. In older fronds they fall away, to some extent, and are then less abundant.

The pinnules are rather rounder and less oval than in C. tomentosa, and though they are somewhat purse-shaped,

SN.

the involucre consists almost entirely of the recurved herbaceous margin, the proper whitish and delicately membranous involucre being nearly suppressed.

The spores are sub-globose, amber-colored, faintly trivittate, and have a finely pustulated or granular surface.

In respect to the narrow herbaceous involucre this fern comes nearest to *Cheilanthes lanuginosa*, of Nuttall, figured at Plate VI of this work. It has, however, much larger fronds; and the copious, though narrow scales of the stalk, as well as the scales of the rachises, will readily distinguish it.

It is among the Ferns which have been cultivated by Hon. J. Warren Merrill, though I am not informed what are its special needs in the way of soil, moisture, etc.

Plate XLV.—Fig. 6-12. Cheilanthes Eatoni from one of Mr. Brandegee's Colorado specimens. Fig. 7 is an enlarged secondary pinna. Fig. 8, a segment still more enlarged. Fig. 9, a part of the rachis, enlarged, and showing the scales. Fig. 10, a scale from the rachis, magnified. Fig. 11, some of the tomentum magnified. Fig. 12, a spore.

